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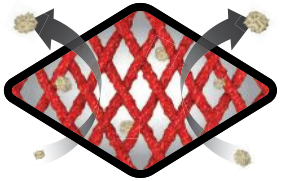

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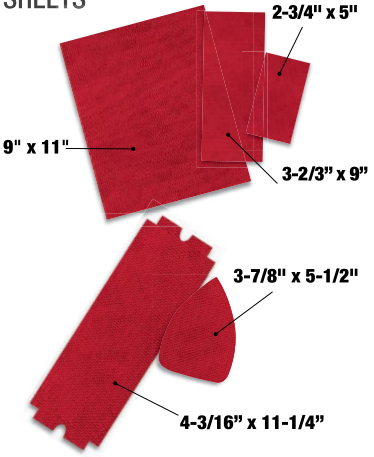

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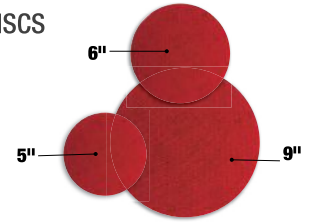

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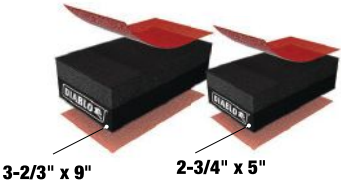

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On the cover: Randy Williams, a builder and energy auditor in northern Minnesota, conducts a blower door test on a house. See the story on page 29. Photo by Randy Williams.

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THE JOURNAL OF LIGHT CONSTRUCTION (ISSN 1056-828X), Volume 40, Number 8, is published monthly except combined issues in Jan/Feb, July/Aug, Sept/Oct and Nov/Dec by Zonda Media, 1152 15th St. NW, Suite 850, Washington, DC 20005. Annual subscription rate for qualified readers in the construction trades: $39.95; nonqualified annual subscription rate: $59.95. Frequency of all magazines subject to change without notice. Double issues may be published, which count as 2 issues. Publisher reserves the right to determine recipient qualification. Canada Post Registration #40612608/G.S.T. number: R-120931738. Canadian return address: IMEX, PO Box 25542, London, ON N6C 6B2. Periodicals postage paid at Washington, DC, and at additional mailing offices. POSTMASTER: Send address changes to JLC, Box 3530 Northbrook IL 60065-3530.

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BY CLAYTON DEKORNE

Checking the Accuracy of Squares and Levels

One of the lessons I learned early as a carpenter was to periodically check squares for square and levels for level. The initial lessons were painful: Once I laid out a library full of built-in bookcases, and then proceeded to cut the sides of the shelf cases on a sliding miter saw that I had adjusted with my out-of-square steel square. The multiple errors were caught only after I had made all the cuts—when I was dry-fitting the cases. My experience with an out-of-level level was less tragic: I had just installed the jambs on some interior door openings with my grandfather's mahogany level—an instrument I revered and assumed to be perfect. Fortunately, my co-worker used a different level to check the jambs for plumb *before* casing the openings.

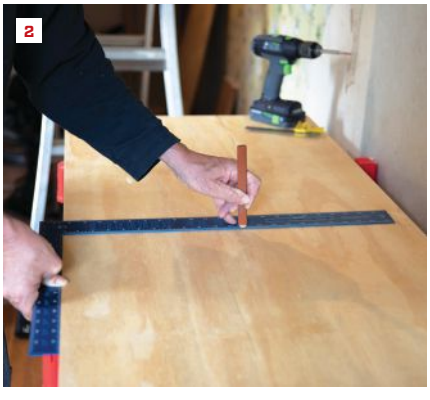
The techniques for checking both squares and levels for accuracy can be done quickly, and I recommend checking your tools regularly when they are shuttled around from jobsite to jobsite.

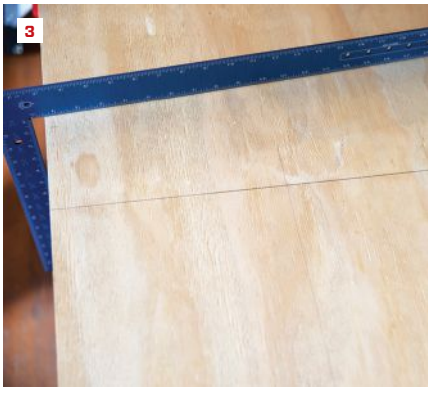
Square check. The procedure for checking a square takes longer to read about than it will to perform, once you get the hang of it.

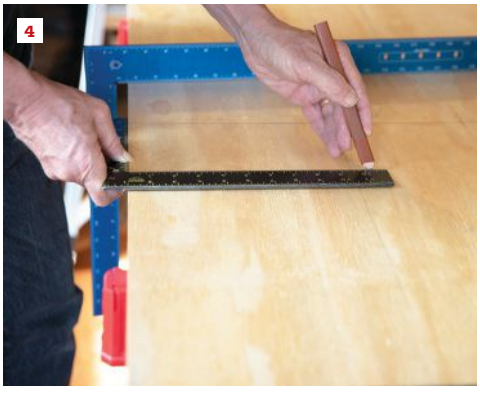
Step 1. Hook the tongue (short leg) of the square along the side of a piece of dead-straight stock. (Alternatively, you can butt the tongue to a straightedge, but clamp the straightedge down so it doesn't move.) Draw a line along the inside of the blade **(1)**.

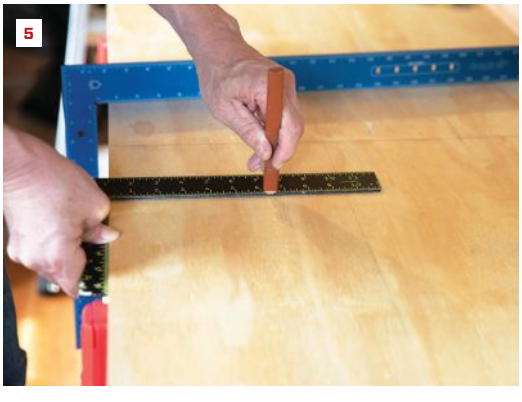
Step 2. Flip the square so the tongue points the opposite direction. Line the base of the blade up with the line you just drew and draw another line along the same side of the blade **(2)**. If the square is square, you will have one solid line **(3)**. If the square is not square (like the short black square I checked in the bottom sequence of photos **(4–6)**), you will see the two lines diverge.

Note: If you can find a straight edge on a store display and draw two tick marks (one at the base of the blade on the display edge and one near the end of the square's blade on a box on the shelf below), you can perform this check right in the store before you buy a square. I was shocked that a whole rack of the more expensive









Photos by Clayton DeKorne

"red" squares at a big box store were out of square, some by quite a lot. There were a few good ones among the less expensive "blue" squares.

Level check. This procedure is also pretty fast, but there a few more steps involved, as you should check for both level and plumb.

Step 1: Hold the level flat against a wall, and adjust the tool until the bubble on the vial is centered between the two lines, reading "level." Mark the location of the vial on the wall. You can make one mark in the center of the bubble, but I usually make a mark at each line on the vial so I can reposition it easily **(7)**.

Step 2: Draw a level line along the length of the level on the wall **(8, 9)**. Note: You can just mark the wall at the far ends; you don't need a continuous line. This can be useful when you are performing the test on a finished wall; you can use three short pieces of blue tape and make your marks on those.

Step 3: Flip the level end for end, keeping the same edge of the level facing up. Line up the vial in the same location using the reference marks, and adjust the level so the vial reads level again **(10)**. You should see that the level is aligned on the level line. If it's not, draw a new line (or make new marks) to judge how far off it is.

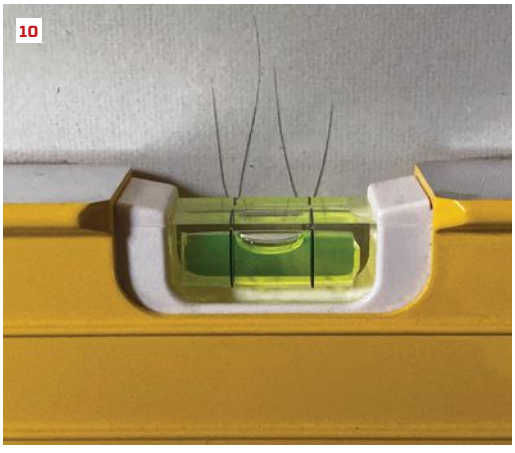
Step 4: Hold the level plumb and align the tool so that one vial reads plumb **(11)**. Now look at the other vial: Both vials should read true. Draw a plumb line (or make marks on the wall at each end of the tool).

Step 5: Keeping the tool vertical, turn it over so you have the same vial at the top end. The opposite face of the level will be facing out, and you should now be referencing the opposite edge of the tool **(12)**. Align the tool on your plumb marks and check both vials. They should both read plumb.

Older levels will have two arced vials within each glass. When doing the test, make sure you are keeping the tool oriented so the same vial is always on top. (You will have to perform the test again to test the second set of vials.) Newer levels like the one shown in these photos have barrel-shaped vials that read level no matter which edge of the tool is facing up. These make life a little simpler, as there are fewer chances for the tool to go out of whack.

When checking a level, make sure to also check that the beam itself is straight. When you hold each edge against a truly flat surface (a solid countertop works well), there should be no daylight visible along its length. Check both edges. Also check the beam faces for flat. Most box beam levels go off when the beam is loaded sideways (like when it's crushed under other tools in the back of a truck) and the beam bends. There's nothing that can be done for a bent level. If the vials are off, you can usually send it back to the manufacturer to reset the vials, but doing that only makes sense when the cost to replace the tool is more than the cost of shipping it back.

Clayton DeKorne is chief editor of JLC.



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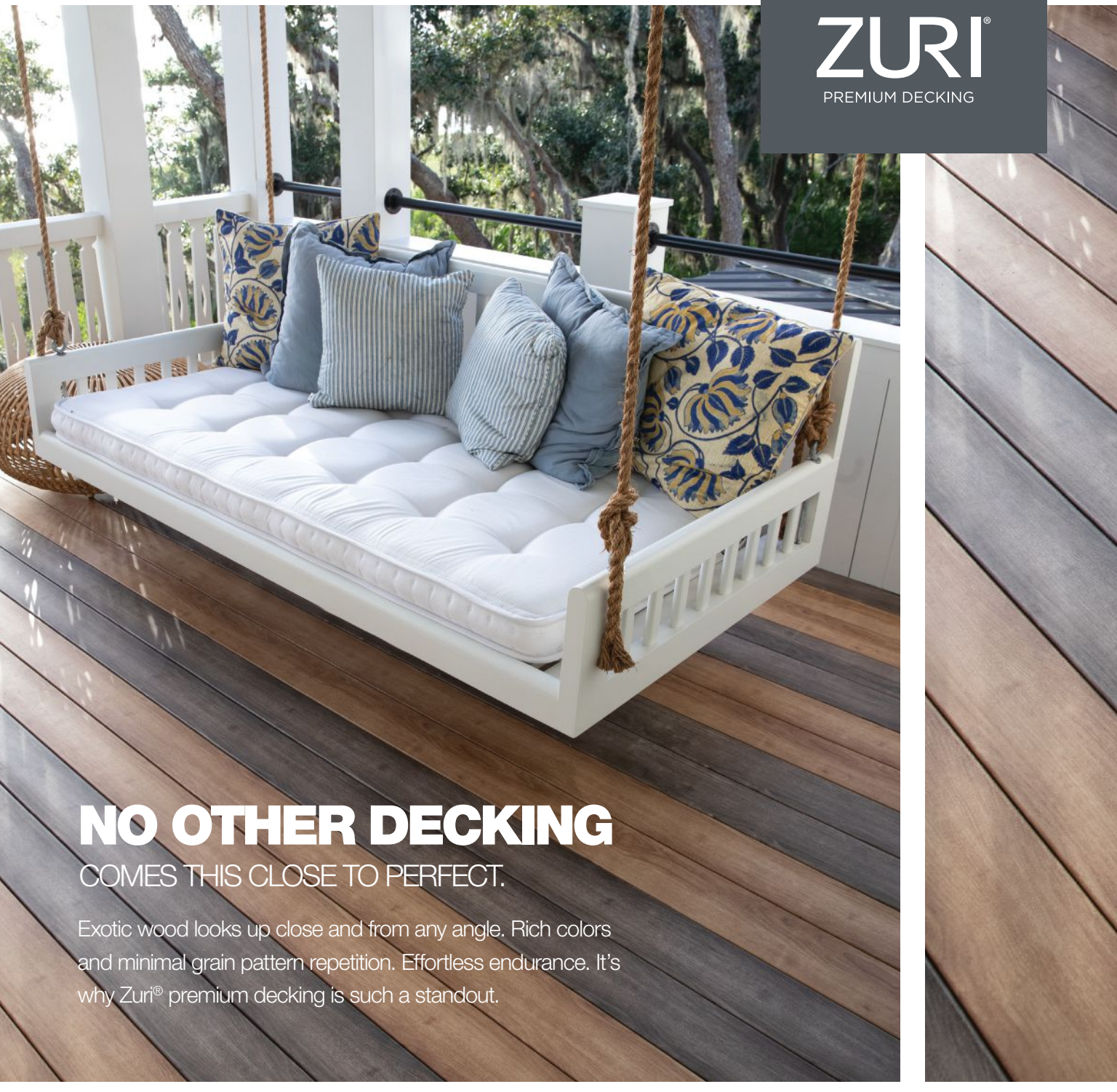

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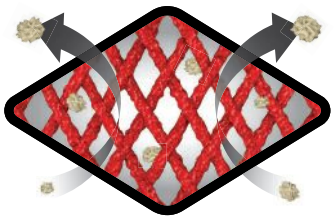

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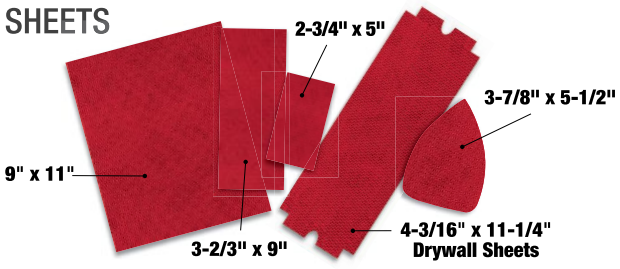

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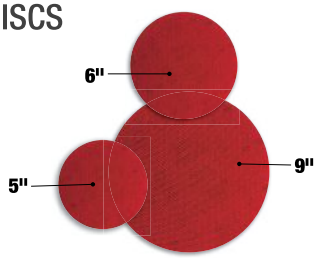

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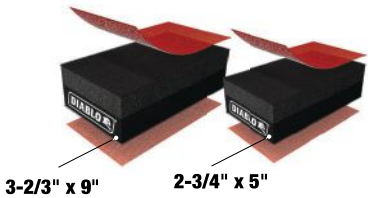

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Q While working on a kitchen renovation project for a client, I was asked to take a look at his deck. He had noticed that a few of the galvanized lag screws used to fasten the ledger to the house had developed some rust and wanted me to replace the rusty screws. Is it OK to put the replacement screws in the same holes, or will the potential pre-existing rust and corrosion in the hole promote early rust on the new ones?

A *Bruce Barker, a licensed contractor and certified ICC inspector who owns Dream Home Consultants, in Fernandina Beach, Fla., responds:* First, determine if it is necessary to replace the screws. If the surface rust can be easily removed and if the deck ledger and the band board/rim joist inside the structure appear to be in good condition, then it is usually acceptable to leave the lag screws in place. You should advise your client to monitor the screws and the wood for deterioration and to replace them if the deterioration becomes significant.

If the rust is deeper than the surface or if the deck ledger or the band board/rim joist is deteriorated, then replacement is recommended. Installing new fasteners—whether screws or bolts—in existing holes is not recommended, however, especially when screws are involved. If the fastener is rusted where you can see it, the wood around the fastener may be deteriorated where you can't see it. It doesn't take much wood deterioration to decrease the load-bearing capacity of the wood and to decrease the withdrawal resistance of the fastener.

Assuming that the wood in both the ledger and the house framing that it is fastened to appears to otherwise be in good condition, the recommended procedure is to fill the existing holes in the ledger so that they are watertight, then install new fasteners in new holes.

If you install new fasteners, be sure to leave enough distance between the old holes and the new ones. Good practice is to locate fasteners at least seven fastener-diameters from other fasteners (3½ inches for a ½-inch fastener). You also need to maintain at least 2 inches of clearance between fasteners and the top and sides of the ledger, and a minimum of ½ inch between a fastener and the bottom of the ledger.

Fastener holes can be a water infiltration point. Check the ledger flashing to be sure it is properly installed.

Galvanized fasteners, and all galvanized hardware, are subject to rusting. This is especially true when used with lumber with copper-based preservative treatments in wet environments. The steel rusts when it reacts with the copper (galvanic corrosion of dissimilar metals) in the presence of water. In most environments, the corrosion process can take a long time because of the sacrificial zinc layer that protects the steel, but it can happen rapidly near salt water. This is why the 2018 IRC requires stainless steel fasteners and connectors for all decks exposed to salt water or within 300 feet of bodies of salt water.

For more information about fastener and hardware corrosion, see "Red Rust on Coastal Decks Is a Safety Warning," jlconline.com (a review of "Coastal decks: red rust on decks is a safety warning" by Frank Woeste, Joseph Loferski, and Bruce Barker, *ASHI Reporter*, January 2019, as reprinted in *Building Safety Journal*) and "BRANZ Study Focuses on Fastener Corrosion" by Skip Walker (jlconline.com).

Iron and hydroxyl ions released as a galvanized deck-ledger screw corrodes **(1)** can attack the cellulose in wood and weaken the fibers **(2)**.

Minor surface rust that can be removed from fasteners is usually not a problem **(3)**. When corrosion is extensive **(4)**, new lag screws or bolts should be installed in new holes in the ledger, and the old holes filled to prevent water intrusion.

Photos: 1, 4 Bruce Barker; 2, 3 courtesy Skip Walker/BRANZ

Q Is there an approved solvent for removing adhesive residue after removing Huber's Zip flashing tape from building materials, such as from the frame and nailing flanges of a clad window? And how about from the hands, after handling that sticky stuff?

A *Mike Dye, a senior product application engineer with Huber Engineered Woods, responds:* Unfortunately, there are no known solvents that can help dissolve the residue from the tape, which uses a proprietary acrylic adhesive. We have heard reports that the use of medical-grade adhesive remover along with a fair amount of elbow grease (scrubbing) can be effective. For your hands, silicone-based products are less likely to dry out and irritate the skin compared with alcohol-based removers. We have also heard reports that acetone (along with a lot of scrubbing) can be somewhat effective, but that approach would be best used with building materials rather than on skin.

Our group is still looking for a less labor-intensive method to remove the adhesive residue, but our efforts are complicated by the fact that most of the tape's adhesive formula is a trade secret that even members of our group are not privy to.

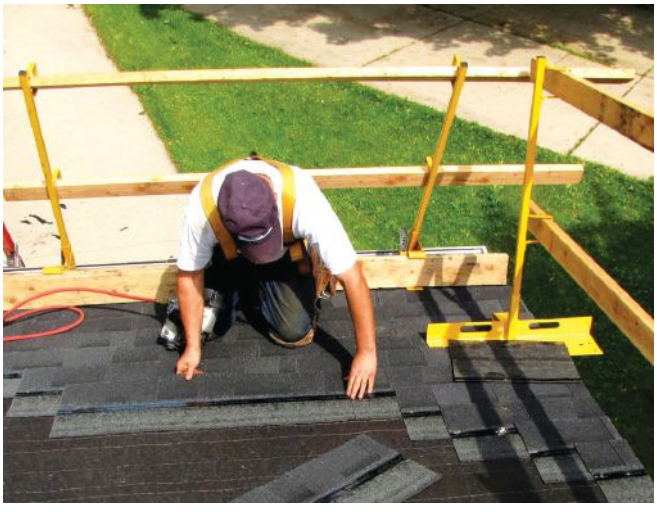
Q Are there OSHA-specific guidelines for installing and using roof jacks? Is any additional fall protection required when working off properly installed roof jacks?

A *Andrew Wormer, JLC's executive editor, responds:* When roof jacks are properly fastened to the roof according to the manufacturer's instructions, they add both an element of safety and a useful work platform on sloped roofs. But Peter Barletta, a compliance assistance specialist working out of OSHA's Boston South Office in Braintree, Mass., says that most of the simple and inexpensive adjustable roof brackets you are probably familiar with aren't equipped with integral guardrails, and unless they are (as shown in the photo at right), they aren't a substitute for an OSHA-approved fall protection system. Barletta says that this would typically consist of a full body harness connected to a shock-absorbing or retractable lanyard hooked to a manufactured roof anchor capable of supporting a 5,000-pound load per attached employee. Alternatively, a personal fall protection system with a safety factor of two could be designed, installed, and used under the supervision of a qualified person. Fall protection is always required on roofs where the distance between the eaves and the ground or a lower surface is 6 feet or greater, regardless of the presence of roof jacks.

Don't use roofing nails to install roof jacks; the shanks are too short, the diameters are too small, and the heads—though broad—will pop off easily. Instead, use 8d or 16d common nails driven through the sheathing into the framing. Most roof jacks are adjustable, and after installation, the platform should be level.

For the most stability and to limit flexing, try to use the widest staging planks that will fit in the roof jack. For example, if the roof jack will accept a 2x10 plank, that is what you should use, not a 2x6 or a 2x8. According to OSHA guidelines, the planking primarily must be able to support, without failure, its own weight and at least four times the intended load. In addition, when fully loaded, the plank should not deflect more than 1/60 of the span; that is, a 10-foot staging plank should deflect no more than 2 inches.

Locate the roof jacks within 6 to 12 inches of the end of the staging planks so that when a worker steps on the cantilevered portion of the staging plank, there is not enough leverage to lift the other end of the plank off its support. If the roof is wide and requires multiple staging planks, overlap them by 1 or 2 feet, locating the overlap above one of the jacks. Fastening the planks together with nails or screws will reinforce the assembly and make it more stable.



Fitted with guardrail holders, these roof brackets act as slide-guards and toe boards while providing fall protection.

Photo courtesy Acro Building Systems

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Reinforcing a Foundation With Structural Strapping

BY JAKE LEWANDOWSKI

Our company specializes in structural restorations, and we are regularly called on to repair basement walls. I have covered a number of techniques we employ for this in past articles; here, I cover the use of structural strapping to reinforce the interior of a basement wall that has bowed inward.

Structural strapping is made from several different materials. The type we're using on the job shown in this article is a woven grid of carbon fiber and Kevlar, which is bonded to the foundation wall with a two-part epoxy.

Foundations fail for many different reasons; typically, the walls are underengineered. Often, the walls lack enough rebar or were otherwise not built as stoutly as originally designed.

The repair for these walls was designed by the client's engineer.

Photos by Jake Lewandowski

Toby Bonilla of Great Lakes Builders smooths out the two-part epoxy used to reinforce a block foundation wall.

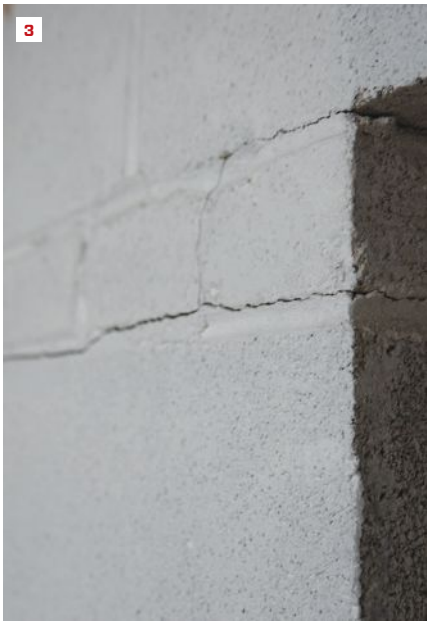
We did not use the full line of reinforcing products available from the manufacturer of the reinforcing straps. (On this job, we used a reinforcing system from Fortress Stabilization Systems; fortressstabilization.com.) Typically, the full product line includes a rim-joist strap connection, commonly called a "neck tie." Additionally, there is a bottom anchor that makes the connection from the bottom of the strap to the existing footing. In this case, the engineer did not employ the manufacturer's additional components, but the effect of his design is similar.

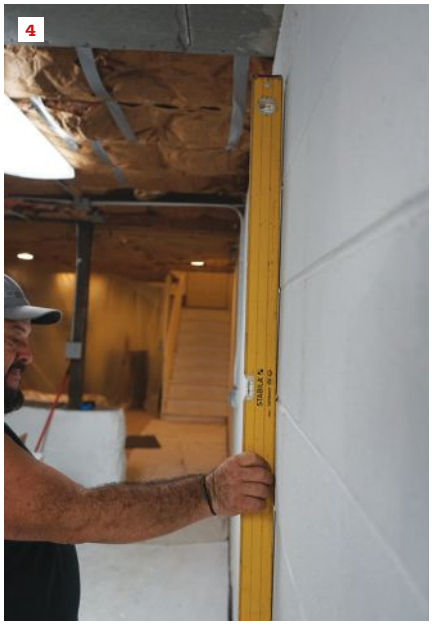
With this project, we were asked to first verify the floor slab thickness in several locations and notify the engineer of our findings. He determined that the slab was thick enough to restrain the bottom of the foundation wall. We also pulled the insulation out of the joist cavities to verify that the sill plate was anchored to the foundation wall, checking for anchor diameter and spacing. We relayed these details to the engineer to verify the sill-to-foundation connection, which he determined was acceptable. However, in some areas, he did ask us to add angle brackets to reinforce the floor-joist-to-sill-plate connection.

After setting up the site with temporary lighting, painter's plastic, an air scrubber, and drop cloths, we laid out the project. On this specific job, the engineer specified strapping "not to exceed 4' 0" on center." We laid out the strap locations on the wall and began to prep the wall by removing the paint with a grinder so we had a clean surface. (If there's no paint present, we usually still go over the strap locations with a surface grinder to ensure a good epoxy bond.) We also pointed the mortar joints and any horizontal cracks so we had a flat surface at each strap location.

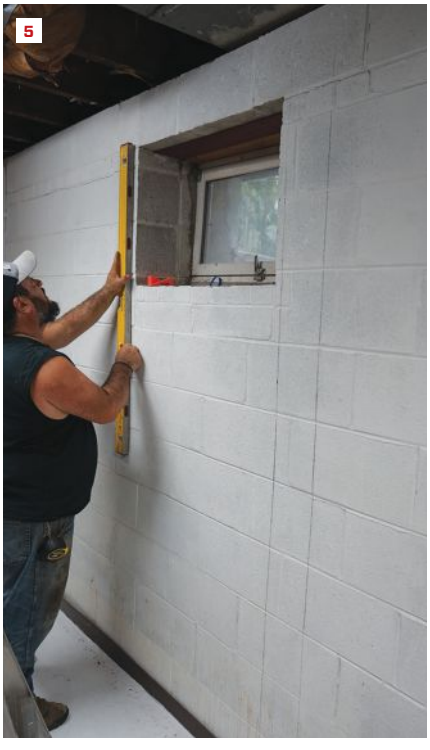
With the wall fully prepped, we were ready to lay down a bed of epoxy, spreading it out to ensure complete coverage. We then applied the strapping, pressing it firmly into the epoxy. The goal is to have the strapping fully saturated and encased within the epoxy. To achieve this, we needed to add epoxy to the outer face of the strap and smooth it out with a plastic applicator. The manufacturer of the reinforcing strap used here requires covering it with a thin sheet of plastic and pressing out any air bubbles that are trapped within the assembly. The thin sheet of plastic must stay on until the epoxy fully cures. We left it on, but it can be removed after the epoxy cures if you wish to paint over the repair.

JLC *contributing editor Jake Lewandowski is a construction manager with his family's business, Great Lakes Builders (greatlakesbuildersinc.com), which specializes in structural repairs in Greater Chicago. Follow him on Instagram: @jakemlewandowski.*





Structural strapping, which is very strong in tension, is typically specified to reinforce foundation walls that bow inward. Photos **(2)** and **(3)** above show some of the tell-tale cracks in a CMU wall in this condition. You can see clearly at the top of the level that Toby is holding how the wall bulges to the inside **(4)**.



Toby draws layout lines for placing the straps every 4 feet on-center **(5)**. Afterward, a helper grinds these areas free of paint **(6)**. Toby then adds grout to the mortar joints to create a flat bonding surface **(7)**.

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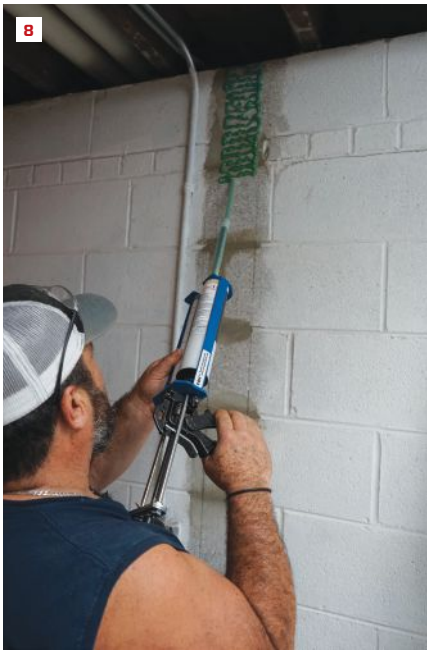
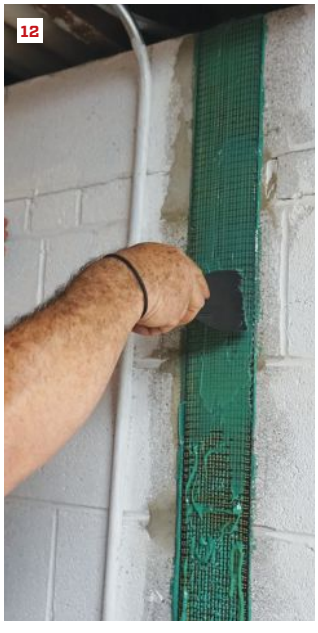
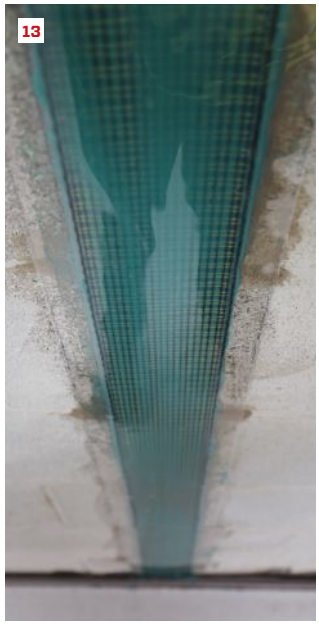


Toby applies epoxy to the wall in a close pattern **(8)**. A helper spreads the epoxy out **(9)** before Toby applies the structural strap, pressing it firmly into the bed of epoxy **(10)**.





The goal is to have the strapping fully saturated and encased within the epoxy. To accomplish this, Toby adds more epoxy **(11)** and smooths it out **(12)**. With this particular reinforcing strap, a thin sheet of plastic is applied on top of the epoxy **(13)**, which completes the project **(14)**.

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Ahoy Mateys! Installing a Porthole in an Interior Door

BY RYAN LABRENZ


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While we were hustling to wrap up a long-running project last fall, the homeowner hit us with an unusual request: "I was at an antique store over the weekend and found this porthole; do you think we can install it in the door leading to the basement?" He was holding a large brass porthole, about a foot in diameter, which was still operable. With the painters queuing up behind us, I told him I wasn't sure I had the tools I'd need to do it, but I'd think of something—fast.

The homeowner was an architect and he had designed the new four-building compound we were trying finish up. The compound consisted of a main house, where the porthole was going to be installed; a piano barn, which housed a grand piano; a pool barn with an Endless pool; and a pool house with a changing room for an in-ground pool. It was an interesting project and the client was imaginative with a good, albeit somewhat eclectic, design sense.

Quickly noodling through the situation, I saw that the porthole's outer brass ring would overlay the hole cut in the door, while an integral, smaller-diameter rim would need to "collar" into the door about 1/4 inch. After a few minutes, I determined the real novelty of the homeowner's whimsical, last-minute request would be making a perfectly round trim-out piece to cover the raw wood hole on the basement-stair side of the door.

The door. I'm not sure if it was serendipity or planned, but the interior door was a Craftsman-style, three-panel shaker design that had a large enough square top panel to accommodate the antique window. The 32-by-80-inch door was constructed of MDF panels with pine stiles.

After removing the door from its hinges, I worked from a pair of sawhorses. I found the center of the panel and marked the porthole's inner opening and outer flange, then marked its focal point **(1)**.

An improvised router base. Starting out, I planned to make practice cuts on some 1-by stock; I wasn't sure I'd be able to rout out the tight, circular trim-out piece without blowing it up. Working on the fly, I took the 1/4-inch plexiglass base plate off my laminate router and fashioned a jig out of 1/4-inch lauan and screwed it on the router (I didn't have time to buy a proper jig attachment). I stapled a strip of aluminum to the top of the lauan to help prevent the router from wobbling and to keep the hole from enlarging or deforming at the pinned focal point during multiple router passes.

For the door cut-out, I halved the 10 3/4-inch inside

Photos by New Dimension Construction


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diameter (ID) size I needed and drilled out a focal-point hole in the lauan jig 5 3/8 inches from the outside edge of the router bit. I pinned the jig to some 1x12 test stock, then made my test cuts, which worked out satisfactorily, so I was good to go.

Moving on to the door, I pinned the jig to the marked focal point and cut the opening in a few passes **(2)**, plunging about 3/16 inch into the MDF panel with each pass until I cut through **(3)**.

Circular trim-out piece. To cover the raw wood edge of the basement-stair side of the door, I had to make a round trim-out piece. I drilled new focal points in the lauan jig: one representing a radius equal to that of the hole in the door, measured 5 3/8 inches from the inside edge of the router bit; and the other representing a larger radius to account for a 1/4-inch lip that would overlay the interior face of door's MDF panel, measuring 5 5/8 inches from the bit's inside edge. I marked these points on the bottom of the lauan jig as "10 3/4 inches OD" and "11 1/4 inches OD," respectively.

It took a bit of trial and error to locate the focal points on the jig. I would measure, then test the distance, and if was off by the tiniest bit, I would try again. Hence, holes for the focal points were drilled to the right and the left of the site-built jig's centerline **(4)**. (This is where using an manufactured jig would've come in handy.)

In another stroke of serendipity, I was able to make the circular trim-out from an 11 1/4-inch piece of wood (had the diameter of the porthole been slightly wider, I would have needed to glue up a couple of pieces, side by side, adding time to this ad hoc project). I cut the "trim disk," plunging 3/8 inch deep on each side of the disk for my two different diameters, 10 3/4 inches and 11 1/4 inches.

I then used an AccuScribe Pro woodworking compass (fastcap.com) to mark a 9 3/4-inch diameter representing the hole I needed to cut out of the trim disk **(5)**. Because I didn't think that I'd be able to then rout out this tight circular trim without it blowing up, I first glued the trim disk into the hole in the basement-stair side of the door with Titebond III **(6)**, then routed out a 9 3/4-inch-diameter hole to create the finish trim-out piece **(7, 8)**.

I mounted the porthole with some brass screws I happened to find on my mobile-hardware-store of a truck **(9)**, then reinstalled the door **(10)**.

After the painters came through—hot on my trail—and did their thing, the result looked pretty good **(11)**. Not bad for an improvised solution to a curveball request at the end of a long project.

Ryan Labrenz is a lead carpenter for New Dimension Construction, in Millbrook, N.Y.

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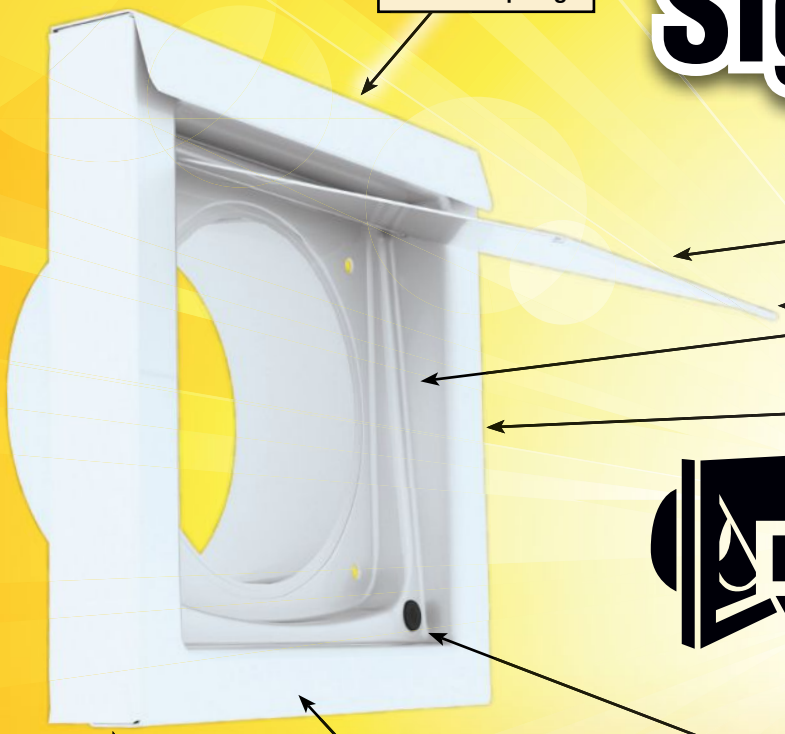
Sight To See



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BY ROB CORBO

Let's Not Kill the Golden Goose

Supply disruptions and inflation from COVID lockdowns, more disruptions and inflation from the war in Ukraine, $5-a-gallon gas, higher truck prices due to microchip shortages, and increased wages to cope with the higher prices resulting from all of the above are pieces of the economic storm we're in. What's a construction business to do? We're at a point when we have to pass along price increases for materials and consider higher wages for employees, knowing they're paying more at the pump and the grocery store. The temptation is to raise our prices. By doing so, however, we enter the vicious spiral in which our response exacerbates the original problem. Raising prices excessively to combat inflation eventually reduces demand and leads to a recession. It's possible the Federal Reserve can avoid that result by raising interest rates and tightening monetary supply, but don't count on it—not because it's the government, but because it's a difficult task.

Even if the Fed can engineer a "soft landing"—avoiding a recession—there may be serious consequences. Raising interest rates and reducing stimulus can decrease demand for goods and services and cause asset deflation. Higher rates discourage borrowing, which means fewer homes (new and old) and remodeling projects are sold. With asset deflation, the stock market and housing markets lose value, and spending is curbed because people feel like they have less money. We have seen stock prices plummet between 10% and 25%. Is housing next? The interest rate on a 30-year-fixed-rate mortgage is now 6.25% (as of this writing), not unreasonable historically but high when applied to all-time-high housing prices. *The Wall Street Journal* reported that for the week ending June 3, 2022, mortgage applications were down 6.5%, the fourth consecutive weekly decline. Housing prices may be coming down, but then longtime homeowners will feel they have less money, recent buyers may end up with homes worth less than the purchase price, and people looking to buy may not know what to do. Demand destruction in housing could be a kick in the teeth for the residential construction industry.

For those of us in construction and remodeling, with continued inflation, we get hurt; with reduced inflation (reduced demand) without a recession, we get hurt; and with reduced inflation with a recession, we get hurt. Employment is high, unemployment is low, and households have cash, so there is hope. But, even so, what do we do when we may get hurt no matter which scenario plays out?

RESIST THE URGE TO ADD TO INFLATION

On December 21 last year, I priced out a good-quality wood screen/glass combination storm door for a client. The estimate came in at $650, $693 with tax. The door was in stock. I added $500 labor to measure, order, pick up, deliver, demo, dump existing, and install. The estimate for the door and its installation came to $1,193, a pretty penny. Once the door was installed, in the spring, we would have the door painted. On March 15, I called to order the door. The supplier gave me a new estimate of $845, $901 with tax, a 30% increase. I wondered if the new quote was for the same in-stock door from December, and it had sat in the warehouse for two-plus months garnering an annualized return of more than 120% for the seller. I wondered if the distributor increased the price $195, or if the lumberyard tagged on some for themselves. My client expressed concern but gave the go ahead.

We had the door inside of a week, confirming my belief that the door had been in the warehouse for the winter. I checked the weather and coordinated the installation date with the painter, a gentleman we had worked with for years. We wanted the door painted immediately after installation and before the next rain. Because the door had no overhang, I requested the painter use an oil primer and two coats of oil paint. All went well until I received the painter's invoice of $850. That was unexpected! My fault for not getting an estimate.

So, the distributor got 30% on a door that didn't cost him 30% more, and the painter got more than twice as much as I expected. (He was one block away, so commuting to the site wasn't a factor.) They entered the vicious spiral, a short-sighted approach to dealing with inflation. A wood screen/glass storm door cost a client $2,251. How many people are going to spend that to have a storm door installed? Economics 101 states that for each dollar increase in the price of a good or service, a group of people will postpone. A number of postponed storm doors is one less employee needed by the storm-door manufacturer, one less carpenter needed to install, one less painter to paint, one less lumberyard attendant, one less distributor employee, one less grocery store cashier, and so on. I am not suggesting that you eat the price increase, just control the greed. If a product price increases 10%, charge 10% more for it, but not more.

It appears some economic pain lies ahead. But if you can handle the pain in a rational and transparent way, your clients will remember. It's hard, of course, when your suppliers and subs are like the door supplier and the painter who put me in an unfavorable position with my client—and I sure will remember.

Here are some strategies that may ease the pain:

Postpone large purchases. I hate to discuss postponing a purchase, because it reduces economic activity, thereby contributing

to a recession. But if you think a business slowdown is on the horizon, it may be best to postpone buying the pickup truck, excavator, or roll-off truck. (Though, if the vehicle is leased and the buyout price was negotiated two or three years ago, it might be worth considering the purchase, depending on your cash on hand, work backlog, and loan rates. You might even be able to flip the vehicle and make a few bucks if the chip shortage remains an issue and vehicle prices remain high.) Even if you have the cash for a capital purchase, it might pay to wait. A slowdown may result in a better price, or supply disruptions may clear, increasing inventories and reducing prices.

Rethink energy. Energy prices also complicate decisions. Diesel prices are through the roof. Can we expect energy prices to drop again, or are those days gone forever? The writing on the wall says that EV will take more market share, fossil fuel's days are numbered, oil and gas exploration will receive less public and private funding, and alternative energy sources will receive more. It's going to take a decade or two to transition energy sources significantly. For now, maybe gas is a better option than diesel. An electric pickup—or even an electric concrete mixer—might be in your future.

Avoid debt. The economy and business cycle are outside our control, but the amount of debt our business carries is not. Debt is risk. Postponing a large purchase helps to limit risk if the economy slows. Reducing balances on lines of credit and credit cards is another way to reduce risk and be prepared.

Inflationary price increases. Price increases aren't usually a problem during a recession; in fact, they should come down. But, during an inflationary period like the one we're in, prices are difficult to predict. The construction trades are particularly vulnerable because we provide estimates to clients for projects that often start weeks or months after agreements are made.

One way to protect your company from having to absorb unexpected price increases is to insert a "material price increase clause" in your contracts and estimates to pass material price increases to your customers. Without one, you may get stuck during fast-moving inflationary periods, and what should have been a profitable job might become a disaster. Keep the clause simple: If prices increase more than a certain percentage from when the estimate was presented or the contract signed, the customer is responsible for the increase. Apply this to a list of materials "including but not limited to" lumber, plywood, siding, steel, flooring, appliances, and so on. Be prepared to show price increases through quotes and material lists accumulated during estimate and contract preparation. Allowances in an estimate or contract may also provide protection. An allowance for doors, windows, hardware, and appliances, priced months before project startup, provides a benchmark for future price increases. A little price protection may help your business survive during a difficult time. Just be sure you openly discuss the clause with clients so there are no surprises.

Flexible employee inflation assistance. As David Gerstel has stated in a number of his books, you take care of your employees. If you do, you will enter any period of inflation with your employees fairly compensated by a combination of wages and benefits. However, even with fair compensation, employees may need, and you as an employer may want to offer, additional assistance during this period of high inflation.

Our present economic situation is multilayered and makes knowing exactly how to provide assistance difficult. Not knowing if 8% inflation is headed to 12% or 4%, or not knowing if credit tightening will curb inflation or create a recession, I suggest you provide flexible or temporary assistance that can be easily changed as conditions change. It would be untimely to raise wages as inflation peaks in the third quarter of 2022 or a recession begins and construction projects disappear. An increase in payroll while there is a decrease in revenues helps no one. Permanent increases in company overhead during times of uncertainty only make it harder to weather the storm. A changeable or temporary benefit, on the other hand, will help employees through an inflationary period and help the company weather a recessionary time. While inflation persists, an employee gets assistance. If a recession occurs, assistance is stopped and hopefully jobs are preserved.

Consider offering a weekly or monthly stipend for gas. Gasoline prices are up 55% in the last 12 months, and a gas stipend may ease the pain of an employee's commuting expense. Their monthly savings can then be applied to other household basics, like food and shelter. The stipend can stay in effect as long as high inflation persists and company revenues continue unabated. Note that I'm suggesting an equal stipend for each employee's commute and not a gas card. A gas card for commuting might be abused or benefit the owner of an inefficient guzzler over more conscientious employees, and might be harder to take away. A gas stipend is only one way of providing assistance; you may decide to use other methods that are more appropriate for your employees or business.

Don't ignore retirement accounts. If demand destruction ends up reducing asset values, it might be a good time to start a retirement account or increase contributions to an existing retirement account. It's only a good idea if your job is secure, your business is healthy, you have the money, and a recession isn't on the horizon. Buying lower is always a good long-term strategy.

THIS IS ONE REASON PROFIT IS IMPORTANT

The economy is likely to get worse before it gets better. If your business has built a war chest from a portion of its profit over several years, you stand a good chance of having your own soft landing. If you haven't created a war chest, now's the time to start, but it may be difficult to do so quickly. Dealing with increased costs and reduced margins, and resisting the urge to raise prices to cover it all, will be difficult if not fatal to a company that hasn't earned a good profit over the years and stashed some away. Having a general idea of what direction the economy is headed will aid your decision making. Gather information from more than one source, and stay away from talking heads that are preoccupied with stirring up emotions. Above all else, remember that it's in your family's best interest if you don't overextend yourself at the wrong time.

Contributing editor Rob Corbo is a building contractor based in Elizabeth, N.J.

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BY RANDY WILLIAMS

Calculating House Volume for Blower Door Tests

A blower door is designed to measure the volume of air moving across the blower door fan at a specific pressure difference between inside and outside the home. In the U.S., blower doors are set up to measure the volume of air in cubic feet per minute (cfm), and the pressure differential is measured in pascals (50 pascals is the standard for residential construction). One of the more common metrics used to express air leakage in a home, however, is air changes per hour (ACH), and the only way we can calculate that metric is by measuring a home's volume.

Measuring the volume of something is straightforward: length times width times height. The problem is that a modern home is rarely built as a simple box. There are crawlspaces and basements, inside and outside corners, and convoluted roof designs that all may or may not be included in the calculation. The first step is to understand what spaces are included, then we can measure and calculate the home's volume.

Photos by Randy Williams

When conducting a blower door test, the author also measures the volume of the house. Volume is needed to calculate ACH50—the metric used to verify the air-sealing requirements of the building code.

The most recent energy code from the 2021 IECC requires all blower door testing to be performed in accordance with either the ANSI/RESNET/ICC 380, ASTM E779, or ASTM E1827 standard. This article will be based on the methods for calculating volume specified in ANSI/RESNET/ICC 380.

CONDITIONED FLOOR AREA

While calculating the volume of a space can be done simply by multiplying length times width times height, we start by measuring the conditioned floor area, or length times width. The 380 standard uses the older ANSI Z765 standard for calculating square footage of a home, which is measured from the exterior finish of the building. All exterior and partition walls are included in the floor-area calculation. A basement might or might not be included in the conditioned floor area; if it is serviced by the heating and cooling equipment, the space *is* included in the conditioned floor area.

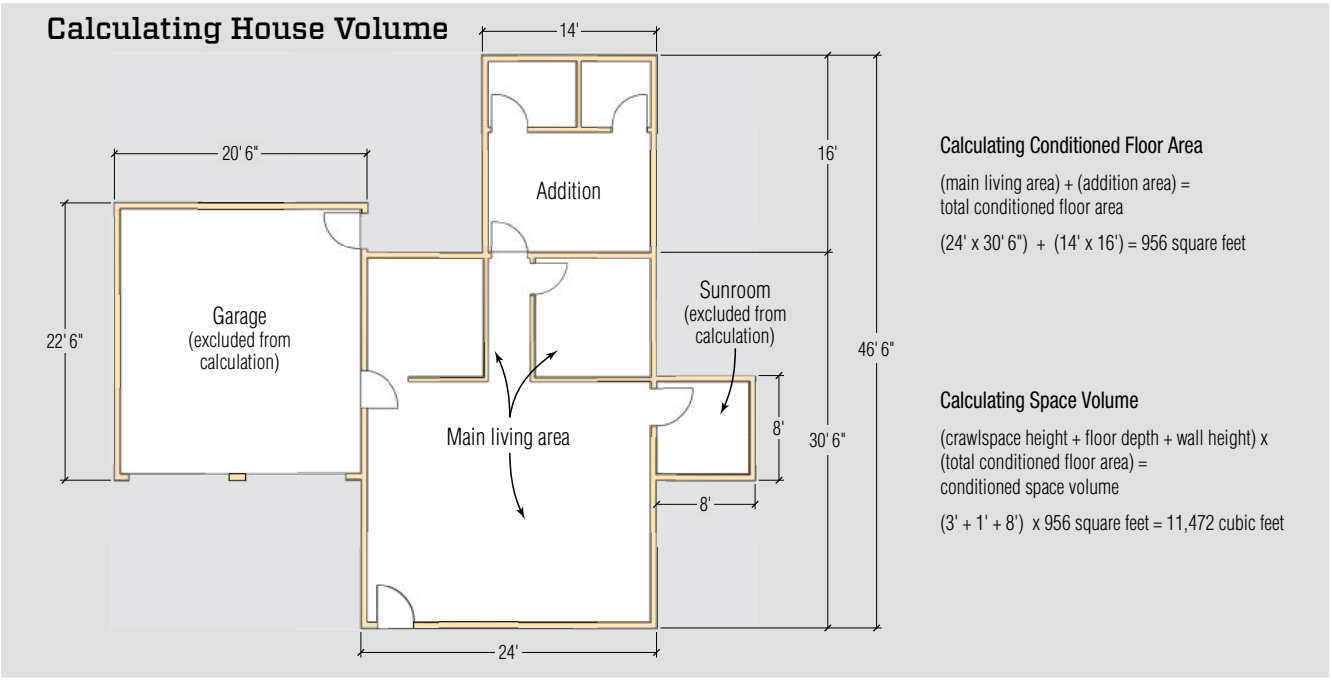
Floor areas that are excluded from the conditioned floor area are those of attached garages (even when they are conditioned), thermally isolated sunrooms, attics (even if conditioned), crawlspaces (even if conditioned), and unconditioned basements. So, for example, in the simple floor plan shown on the next page, the attached garage and sunroom would be excluded from the conditioned floor area. This leaves the main area of the home, 24 feet by 30 feet 6 inches, and the addition, 14 feet by 16 feet, for a total conditioned floor area of 956 square feet as measured from the exterior of the building.

CONDITIONED SPACE VOLUME

Once we know the conditioned floor area of the structure, we can begin measuring the height to calculate volume. This volume calculation will usually include any space between two floors; for example, the space between a first and second level would be included as long as both floors are conditioned. According to the 380 standard, a space is considered "conditioned" if the evaluating party has either:

"Obtained an ACCA Manual J, S, and either B or D report and verified that both the heating and cooling equipment and distribution system are designed to offset the entire design load of the volume; or

"Verified through visual inspection that both the heating and cooling equipment and distribution system serve the volume and, in the judgement of the party conducting the evaluations, are capable of maintaining the heating and cooling temperatures specified by the Thermostat section in the Building Component Column of Table 4.2.2(1) of ANSI/RESNET/ICC 301."



Per ANSI/RESNET/ICC 380, the attached garage and sunroom would be excluded from the conditioned floor area. This leaves the main area of the home, for a total conditioned floor area of 956 square feet as measured from the exterior of the building.

One complication to the 380 standard is that a conditioned attic or crawlspace, which is not ordinarily included in the conditioned floor area, may be included in the conditioned space volume if a door or hatch is opened to the space during the blower door test.

Using the simple floor plan (above) as an example, if that home had a conditioned crawlspace or basement, the volume of that space would be included in the overall volume of the home. So, if the home had a 3-foot-deep crawlspace, a space between the crawlspace and main level of 1 foot, and 8-foot flat ceilings for the main level, the calculation would be: 12 feet (3 feet + 1 foot + 8 feet) x conditioned floor area of 956 sq. ft. = 11,472 cubic feet of conditioned space volume.

What happens if there is a vaulted ceiling or some other complicated roof detail somewhere in the home? That space would be included in the conditioned space volume. Measuring the volume of a simple vault or cathedral ceiling isn't difficult, unless dormers or some other convoluted rooflines are also included in the vault.

Often, calculating the volume of a home will take much longer than performing the blower door test; when a home is complicated, I usually perform the math to calculate volume in my office after performing the test. On very complicated homes, I may use architectural software to aid in the calculation.

ALTERNATIVES TO THE STANDARDS

Standards are the recommendation; I personally do not follow all of the 380 standard. For example, I disagree with measuring the structure from the exterior. In my heating-dominated climate, it's common for the main air control layer or air barrier to be located on the warm-in-winter side of the exterior wall and roof assemblies. To me, it makes sense to measure area from the interior. (It is also difficult to measure the exterior of the home during the winter months when snow impedes moving about the outside of a home.) The code officials I have discussed this with agree with the thinking and allow the variation of the standard. On the downside, measuring from the interior does result in a smaller volume, which makes it more difficult to pass the blower door test.

If you want to deviate from the standard, have a discussion with your local authority having jurisdiction and be consistent with your practices.

HOW I MEASURE

I start my measuring process by making a simple sketch of the home's floor plan. This can be done from either the interior or the exterior. Moving around the home also gives me the opportunity to check for any concerns before testing. After producing a sketch, I begin measuring. I prefer to use a laser measuring device, but I sometimes will also use tape measures and measuring wheels. Lasers work well if you have a line of sight between the two areas being measured; occasionally, it will be necessary to add measurements of several different rooms together to achieve a total length. I do round measurements to the nearest quarter foot.

Once I map the floor plan, I measure the heights of the various spaces. Homes with flat ceilings are easy; to accurately calculate

The author's tools: laser measure, measuring wheel, and long tape measure.

the volume of a complicated home, however, you may be required to calculate volumes of spaces with triangular, trapezoidal, or curved sides.

It is possible to use a set of architectural plans to calculate the volume. Or you may be able to import a digital copy of the house plans into a software program, which then can be scaled to allow for accurate volume calculations. This can speed testing, allowing you to calculate the volume off site. But it's not uncommon for a home to vary from the plans, so be sure to verify the measurements at the time you conduct the blower door test.

The architect or designer may be able to calculate the volume for you. I had a discussion a while ago with Alexandra Baczek, an associate at Steven Baczek Architect, on using software to calculate volume. She said, "We have used SketchUp in the past for the purpose of translating volume metrics to energy consultants. SketchUp has the ability to quickly generate the volume of a model, but like anything, that metric is dependent on the accuracy of the model. For a simple house, it's pretty easily achieved; for a more complicated house, the complexity is relative." Remember, whether you or a designer calculate volume from the plans or a software model, you need to back that up by confirming measurements on site to verify the accuracy of the calculation.

LOCAL CODE VARIATIONS

Be sure to check any local code requirements when it comes to calculating a home's volume for blower door testing. The energy code in Washington state, for example, caps the ceiling height used for calculating volume at 8.5 feet. This includes the height of any cathedral ceilings. It is easier to pass a blower door test in a home with a large volume than in smaller homes. I believe this is Washington's attempt to level the playing field.

THE ACH50 CALCULATION

Once you've measured the volume of the home and run the blower door test (which will normally be shown as cubic feet per minute of airflow moving across the blower door fan), you can calculate the air changes per hour at 50 pascals of pressure (ACH50), which is what the code is looking for as the pass/fail metric of a blower door test. The formula is the rate of airflow in cfm x 60 minutes in an hour / volume of the home = number of air changes per hour.

As an example, a home had a blower door test of 750 cfm and a calculated volume of 12,000 cubic feet. Using the formula, 750 cfm x 60 minutes / 12,000 cu. ft. = 3.75 ACH50. This home would pass the blower door test in areas of the country where the test result must be 5 ACH50 or less but not where the requirement is 3 ACH50 or less. It's important to know the requirements in your area.

AIR CHANGES VS. AIRFLOW

While ACH50 is the metric required by code, it is not necessarily the best metric for determining the tightness of a structure. A home does not leak in its volume; air leaks happen on surfaces, specifically the exterior shell. To demonstrate, consider the calculations for the smallest and largest homes I've tested to date:

The smallest was a 696-sq.-ft. home built in 2018. In a code-required blower door test, the volume of the home was calculated at 6,333 cu. ft. with airflow at 316 CFM50. This home barely passed the blower door test at 2.99 ACH50. (Code requires 3 ACH50 or less in my area.) To put that level of tightness in perspective, a clothes dryer and bath fan operating at the same time in this home might be capable of producing a negative pressure of 50 pascals, the same as a blower door test. The home is tight.

The largest home I've tested was a seasonal log cabin just over 5,000 sq. ft. with a cavernous volume of 99,076 cu. ft. The interior peak of the main cathedral ceiling was 25 feet high and the structure had a 4-foot-high conditioned crawlspace. The crawlspace is not included in the conditioned floor area of the home but is included in the conditioned space volume. This blower door test was part of an energy audit. The home's leakage rate was 5,306 CFM50, or 3.21 ACH50.

The air change rates of the two structures are similar, but with very different airflow rates. There are other metrics for showing different leakage rates of a home; the best, in my opinion, is cubic feet per minute at 50 pascals per square foot of surface area. I'll discuss that another time.

CONCLUSION

For the vast majority of blower door tests I conduct, I spend much more time calculating volume than performing the test. The final air-changes-per-hour calculation will only be as accurate as the volume calculations. Understanding what areas are and are not allowed to be included in the volume of a home also plays into the test's accuracy. The ANSI/RESNET/ICC 380-2019 standard is currently the best source of information on performing blower door testing for code compliance.

Randy Williams is a builder and energy auditor in northern Minnesota. Follow him on Instagram at @northernbuiltpro and his blog at northernbuilt.pro.

Don't be AFRAID to be BOLD

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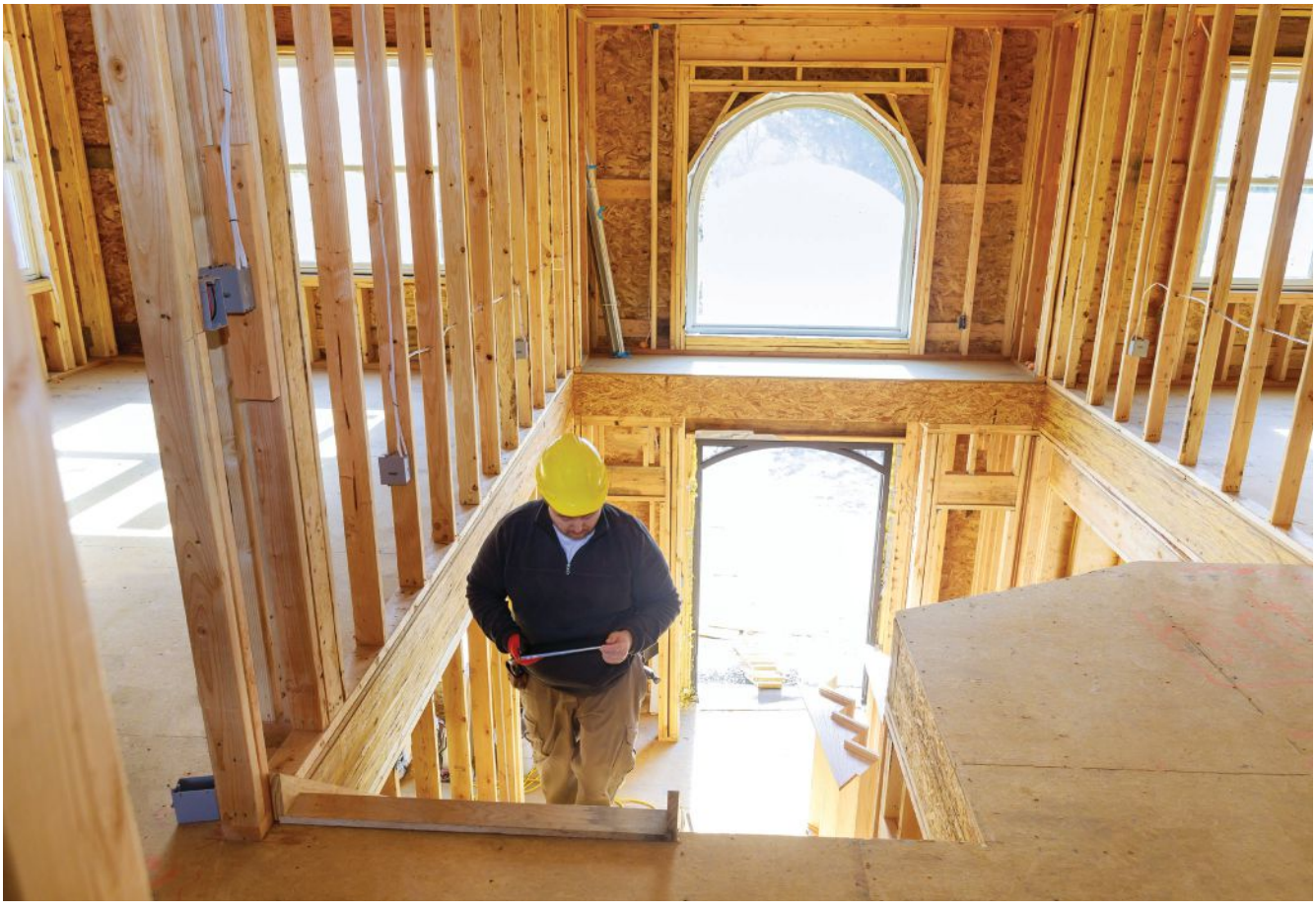

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Inspecting the Inspectors

A survey examining the building code enforcement process

BY JLC STAFF

The results of a survey we sent out through the *JLC* newsletter give a mixed report of the performance of municipal, county, and state building code agencies. The survey is neither a comprehensive nor a quantitative assessment. Rather, it provides a broad look at how building professionals feel about the building code process and examines any changes to it due to the pandemic. Among the 130 respondents, 16 code officials weighed in to give a self-rating and provide a contrasting point of view.

BUILDING DEPARTMENT RATINGS

To get an impression of how builders felt about their experiences with the building departments they worked with, we asked respondents to rate their experience on a scale of 1 to 5, with 1 being "poor" and 5 "excellent." The results shown (see "Rated Experience With Building Departments" on the next page) reflect the responses from building professionals, but exclude those from building officials (which were all 5s, except a couple of 4s from officials who recognized there is room for improvement—but nothing lower).

For almost 40% (those building professionals who provided ratings of 4 and 5), the experience has been mostly positive. Explanations of each rating choice included words like "cooperation," "ally," "team," and "respect." These are some examples:

"They are available for same day inspections, and answer our calls even after hours." [5]

"I typically only work in my hometown and I have a good relationship with the building department as a whole. I treat the inspectors with respect and [in turn] they do the same for me." [5]

"For the most part we have good relationships with the building departments we work with. The struggle is when they don't get what they want from the project engineers or architects." [4]

"The building commissioner (with whom I've had other good interactions in other towns where he also serves) was helpful with questions, responsive to requests for inspections, and generally acted as an ally in getting the project done to code specs." [5]

The most common rating, 3, could be interpreted as "OK," but the explanations for the rating often express something more nuanced. Many selected 3 because of a mixed experience: Either the respondent described working in different jurisdictions or expressed varied experiences with different officials within the same jurisdiction. A number of building professionals who selected 3 also included constructive critiques. For example, several suggested that inspectors were capricious, enforcing their interpretation of the code because they had the prerogative to do so, even on details that passed muster with plan reviewers and often were felt to have little significance to the safety or performance of the building.

Other examples of responses associated with a 3 rating included:

"They keep moving the goal posts. What would fly a month ago won't last week."

"The employees in the field worked very hard and after the initial shock of the shut down (or lack of one for them) they were fantastic under the situation. I would give them a 5. The staff downtown have been a complete cluster $&@!. City hall shut down completely, then went to 'by appointment only.' What a joke."

"In the end, an inspector has no financial or legal responsibility to anyone involved in the project, while the contractors, architects and engineers have their licenses, livelihood, and reputation at stake every time."

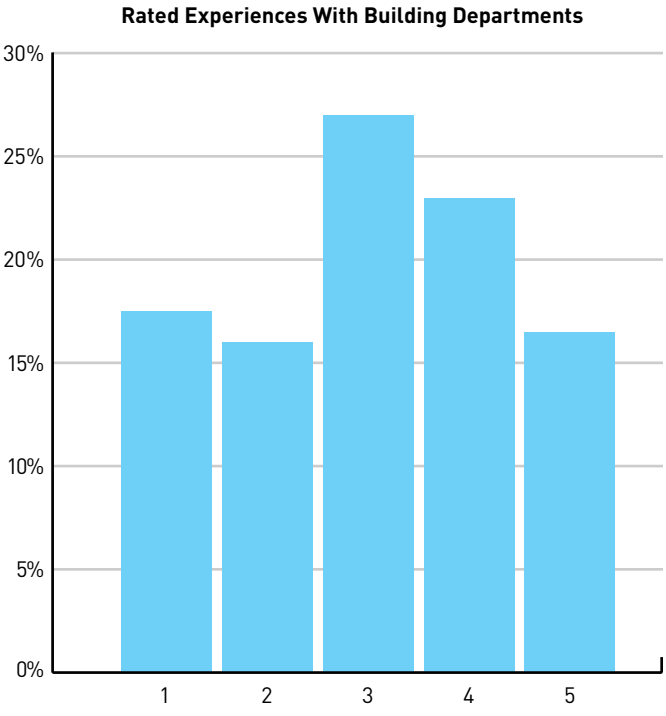
PANDEMIC EFFECTS

What initially prompted our survey were rumblings we had heard from readers that, of all the challenges facing building professionals today—more than labor shortages, high material prices, and extended lead times—complying with local regulations was the problem they now found the hardest to solve. In our survey, this problem manifested in responses as long delays, higher fees, and difficulty communicating with building departments (largely owing to staff shortages and reduced access to officials).

Even though the pandemic has changed how almost every jurisdiction conducts business, not all are experiencing lingering effects. For about a quarter, things are simply "back to normal."

When asked "Did the processes for pulling a permit, conducting a plan review, or having a project inspected change during the coronavirus pandemic?," about a third reported positive changes resulting from moving more of the process online. These are some responses in this cohort:

"Transitioned to online inspection requests saving much time for our staff."



On a scale of 1 to 5 (1 being poor and 5 excellent), respondents rated their overall experience with the building departments they work with. The results shown in the bar graph above are those of building professionals only, with the responses from code officials left off.

"Most departments have done a decent job keeping their processes working or improved. I would say they are on par with managing pandemic-related issues as good as any other business."

But for the majority, the responses to the "what changed" question, were dubious or negative. For example:

"Less face to face, more 'leave application in the box.'"

"Changed significantly. The time period has changed from the legal 30 days to 60+ days to get a permit. To boot, some building departments have added fees to expedite the process. This is on top of the $15 to $22 per $1,000 building fee. So [the cost of the permit on] my job at $1,450,000 is $21,750."

"You call the county code hot line [but you're] lucky if you even get a call back. The phone number online is no longer working and has been changed."

For some jurisdictions, there has clearly been a learning curve. As jurisdictions adapted to policies initiated during the pandemic, practices that were at first shaky have improved and even resulted in efficiencies baked into a new way of conducting business. As one respondent explained: "Initially after the first lockdown, everything was a mess. A lot of things were moved online eventually and the processes were made better. The building department has

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Building Permit Application Requirements

- Fill out the permit application completely and verify that all information, including the full address, is accurate. Incomplete applications or application packages shall not be accepted.
- The scope and total cost of all proposed construction is required to be documented on the application.
- The application must include the correct parcel control number (PCN) for the location address. *The parcel control number can be obtained by accessing the Property Appraiser Public Access website .*
- A copy of the recorded Warranty Deed must be submitted with the application package if the Property Owner is a new owner.
- All relevant contractors must be registered and in good standing with the City of Westlake prior to permit issuance.
- A digital (.pdf) copy of the completed application, plans, surveys, and all supporting documents must be submitted **via email** to building@ gov.com prior to hard copy submittal. See following page for a list of required documents.

3

JBMITTAL REQUIREMENTS

Initial Submittal

- For Rapid Online Service Intake (ROSI) users - Immediately after scheduling a timepoint, please upload your files at the ROSI FTP webpage.
- For all other users - Within two business days of your intake appointment, upload your files in a single folder at the Uploading Your Project Files webpage. Place all files on the root folder; do not use subfolders.

Resubmittal/Revisions - Follow the instructions at the Resubmittal/Revision Service webpage.

FORMATTING REQUIREMENTS

1. **PDF or PDF/A** - Export documents as PDF or PDF/A, compatible with Adobe Acrobat Version 9.0 or higher.
   - **Exported PDFs are required for most projects** - A PDF exported from the native file (not a scan saved as a PDF) is required for most projects. Scans are accepted only for supporting documents and for single-family additions or alterations; in these cases, scan at 150dpi minimum and 300dpi maximum for acceptable legibility and file size.
   - **Text-searchable** - For scanned or non-searchable PDFs, apply Optical Character Recognition to the document.
   - **Separate sub-trades** - Create a separate PDF for each sub-trade or plan review item; see page 2.
   - **Supporting documents** - Save calculations, forms, cut sheets, etc. as separate files from the plan sheets.
   - **Drawings** - All layer information must be removed and flattened into a single layer.

While changes have not been implemented in all jurisdictions, many are saying goodbye to submitting applications in person and conducting over-the-counter plan reviews **(1)**. For better or worse, many jurisdictions have switched over to a digital permit application and plan review process. Examples of the requirements for each are shown **(2, 3)**. While this is perceived by many as an improvement that's supposed to save driving, wait times, and parking hassles to visit the building department, there is a steep learning curve for others, and the new processes don't always save time. Builders say the document submission requirements can be overly complex and claim some building departments are hiring staff with more computer skills than building knowledge.

become much more responsive to email communication and that continues to this day. It used to be that I would never communicate with the building staff in any way but in person. But now I trust that they will respond to my email and they consistently do."

Comments went beyond reflections on bringing communications with building departments into the 21st century. Almost 70% of responses to the question about what changed during the pandemic mentioned a significant digital transformation to the code enforcement process, affecting applications for building permits, plan review, and building inspections, in particular.

Permit applications that must now be submitted online were mentioned most often when specific process changes were described. These are some examples:

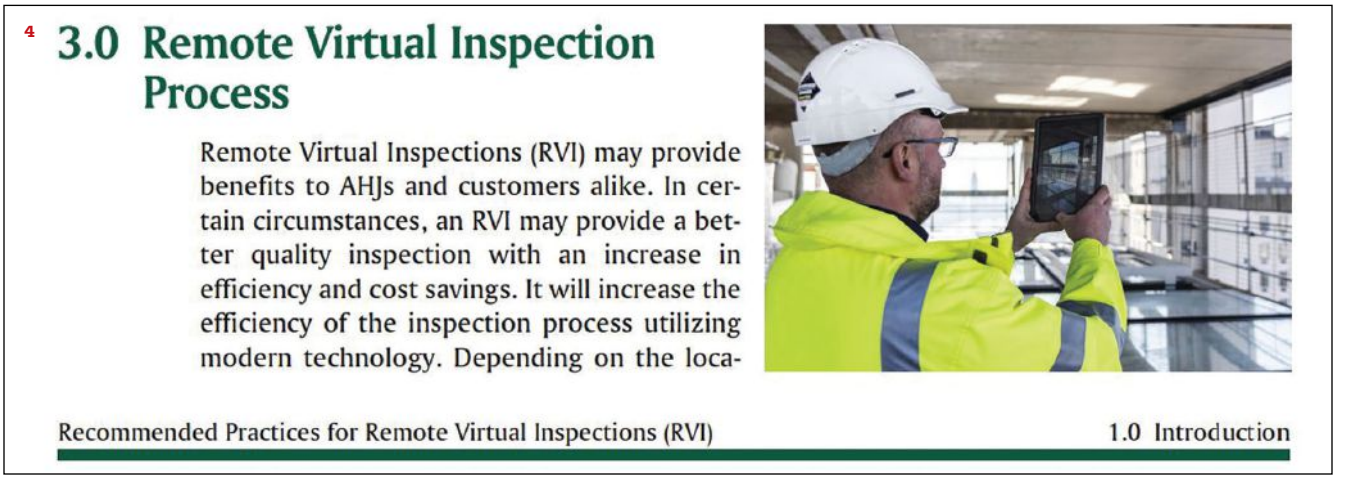
"A little more online presence and no physical applications accepted. With a little learning curve I believe the changes are faster and permanent."

"We couldn't go into the building at first, just leave and pick up paperwork in drop box outside. Then after 5–6 months they let us go into lobby for same. Now we do all the permitting with PDFs online. They still do drop offs, but it's much easier to do online."

"Most all applications and reviews are handled in an electronic format (no more walk-in paper applications w/ over the counter reviews)."

"Permits are significantly harder to pull, demand more requirements with online submissions only and time delays are outrageous."

Plan review seemed to garner the most negative reviews when specific process changes were described. The biggest complaints


4

3.0 Remote Virtual Inspection Process

Remote Virtual Inspections (RVI) may provide benefits to AHJs and customers alike. In certain circumstances, an RVI may provide a better quality inspection with an increase in efficiency and cost savings. It will increase the efficiency of the inspection process utilizing modern technology. Depending on the loca-

Recommended Practices for Remote Virtual Inspections (RVI) 1.0 Introduction

Protocols for conducting "remote virtual inspections" had been defined by the International Code Council prior to the pandemic. This helped jurisdictions respond quickly at the height of the pandemic to keep officials and workers safe.

concerned overly complex file naming and formatting procedures. Several mentioned jurisdictions not being able to accommodate Apple platforms. But added office time was the most cited issue:

"Plan submission in digital format was required. Like me, reviewing digital plans takes the departments longer than paper plans."

"No interaction with plan checkers, so they could request items that the code allowed to be changed without recourse."

"Most of the plan checkers are new hires that [know] little about building. It's frustrating to have to jump through a lot of hoops and have some kid push back something, delay the process, and take time before you can point out that they are misapplying the code."

Less onerous than delays, but adding unexpected complexity to the job, at least one instance of this digital transformation has led to a new level of transparency and new challenges in client management: "Electronic submittals, rather than in-person submittals, might be institutionalized. We've had a couple of Zoom conferences with plan checkers that the client heard about and wanted to be included on. We never had clients asking to come along to over-the-counter plan checks."

Inspections. Changes to the inspection process during the pandemic garnered the most favorable feedback from building professionals. Remarkably, this phase of the code enforcement process was cited most often as the one returning to an in-person process, though not in every case.

"Most inspections were conducted remotely, using photographs and videos submitted by contractor."

"Photo inspection was more widely accepted and seems to be staying that way."

"Everything became electronic—pulling permits, scheduling inspections, inspectors did not go into projects so we would take photos, all paperwork was electronic. The City put a lot of money into the new system so electronic means continues. Saves time actually."

The rapid operational shift by some building departments owes enormous credit to the International Code Council, which was quick to pull together and distribute protocols for "remote virtual inspection" that the organization had been working on for some time before the pandemic. (These protocols are available from the ICC in "Recommended Practices for Remote Virtual Inspections" as a free download at iccsafe.org; see excerpt, above.)

Timeline. Digital changes have not necessarily made the process quicker. Among responses that mentioned the timeline of the code process, more said that it has become longer than celebrated the process being shorter. These examples give some idea of the range:

"Inspections could take up to 10 days to be conducted and pushed back on the day of the inspection."

"Extended time a lot. Over the counter permits now take 2-3 weeks."

"Time of permitting 60 to 90 days and inspections some times 10-days out and things fail for no code violations [but] things the inspector [didn't] like."

"Longer review times allowed for the plan review (from submission of permit for new construction to the issuance of a building permit) was and still is excessive, about 3 to 4 weeks."

"It went all online. Which in some ways was nice, no more waiting in line downtown. But sometimes it took a lot longer with emails to get simple details on the same page, which [when in person] used to take 5 seconds."

CODE-OFFICIAL RESPONSE

While the responses from building professionals tended to be critical of recent changes in the code-enforcement process, the responses from building officials deserve attention, too. They were balanced, and while self-ratings were at the high end of the scale, the comments reflected the pressure officials have had to endure.

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While there were a lot of complaints about it, there were just as many acknowledgments that the building code process is important to ensure the safety of occupants and the structural integrity of buildings. Respondents especially praised inspectors who were more interested in education than in enforcement.

As government entities, they have been subject to pandemic protocols that few in the building community have had to abide by. Village, town, county, and state offices have been under a microscope by politicians, the media, and the public much more intensively than the building community (though no one who was "essential" escaped scrutiny from some critical corners). While it can be argued (as many respondents suggested) that some code officials seem to savor the role of petty official, many others embrace their role as educators and public safety advocates.

One deputy building official and plans examiner's response merits reporting, we think, because the level of detail reveals the complexity in accommodating a wide range of demands and setting a high bar on what the building code enforcement process could be:

"For several years I had been trying to shift my department to a digital plan review system, but the organizational inertia was difficult to deal with. With the onset of COVID and the sudden desire to shift to a contactless permitting system, I was able to implement a digital plan review system in a matter of days. We no longer accept paper plans except in extreme circumstances (e.g., applicant has no computer access and plans are hand drawn). Switching away from paper has cut the time spent on individual reviews almost in half in markup time and freed our permit coordinator from digitizing final plan sets. Now applicants email us the application and plan sets and we do our reviews and email the plans and permit card back for the applicant to have printed. Fire sprinkler permits still have to be paper copies, because my Fire Marshal won't upgrade his screen size. We briefly tried video inspections, but our cell coverage is dreadful and it was easy enough to put limits on contact that still allowed for in-person inspections. These changes will not revert. We are upgrading our 20-plus-year-old permitting software to a system that includes a permitting portal to smooth intake and issuance of permit documents.

"Our goal is that a person should be able to sit down in their backyard, imagine a new deck, draw it up on some third-party free deck software, submit it, and receive the approved plans, all from their phone. No trips to city hall required, and for the paper plan set on site, they can send the documents to a print store and have only the hard copies they need printed."

GENERAL CODE ISSUES

Shifting away from changes in process, we also asked respondents about their overall impression of the building codes and what they felt needed to be improved. About 63% of respondents used positive terms, mostly recognizing the need for "safety" and "public health" (stairs, guardrails, and sewer were mentioned most frequently here), or cited simply "no issues."

Around 16% of respondents remarked that building codes were "minimal standards," which they tried to exceed. Words related to "inconsistent" were the ones used the most frequently to criticize the building code in general.

Only 6% responded "no comment" or ranted. Few of our survey participants seemed to object to the intent, only the means.

Blind-Side Waterproofing

Pre-applied waterproofing and concrete liner walls help rescue a hillside structure

BY DOUG HORGAN

An unusual remodel called for some heavy engineering solutions and gave us the chance to try something we'd heard of but never tried: pre-applied waterproofing, also called "blind side" waterproofing.

Normally, we pour concrete foundations between forms on the inside and outside, then strip the forms and waterproof the outside surface, which is accessible from the overdug area around the foundation. Pre-applied waterproofing is used when a concrete wall is poured up against a surface that won't be stripped out later. The concrete can't be accessed on the outside surface after it's poured, so waterproofing must be done before the pour.

I'm most familiar with pre-applied waterproofing in big commercial projects. City tower basements are excavated using shoring methods to hold back the dirt around the property line, then foundations are poured up against the shoring, with removable formwork only on the inside. Waterproofing has to be installed between the shoring and the poured concrete for it to work on these multilevel basements. (Interior waterproofing is not a preferred system when poured floors attach to the inside of perimeter walls.) You can see this work as you go around town, but I got more info from attending meetings of the Building Enclosure Councils in Washington, D.C., and Baltimore, each of which has organized lots of great educational events, including some on these waterproofing systems. Your town may have a similar group focused on

Photos by Doug Horgan; illustration by Tim Healey

building details and building science, and if it's anything like ours, it's a great way to learn.

RESCUING THE HILLSIDE STRUCTURE

Our project was to fix a masonry building built up against a hill. The attached structure housed an exercise room on the main level, which was accessed through the garage and small mechanical space. The doors of the exercise room opened onto the lower patio area, while a set of exterior stairs led to an apartment and upper patio area on the second-floor level. On the uphill side, the room's right and back walls were below ground level, with the back wall extending up another 3 feet to retain dirt on the hill above it (see plan and section details on page 40).

The interior of the building was in poor condition, and we stripped the drywall as part of the planned renovation. In addition to revealing an impressive termite situation, we found large cracks in the 12-inch-thick, reinforced block wall, which made it seem that the building was being pushed down the hill. (The top of the front wall was pushed out significantly as if the upper slab had been pushed down the hill a few inches and had broken the stucco on the front).

Liner walls and deadmen. It was time to bring in an engineer, who prescribed new, heavily reinforced concrete walls poured interior of the existing block walls, tied into grade beams and retention structures in the hill above the building. The purpose of the new "liner" walls, as he referred to them, was to take over the structural functions of the existing block wall. These new 6-inch-thick walls were tied into the upper patio's slab with rebar dowels through holes cored into the slab and, at the bottom, doweled into the block wall's existing footing. All in and cured, it was a very solid system.

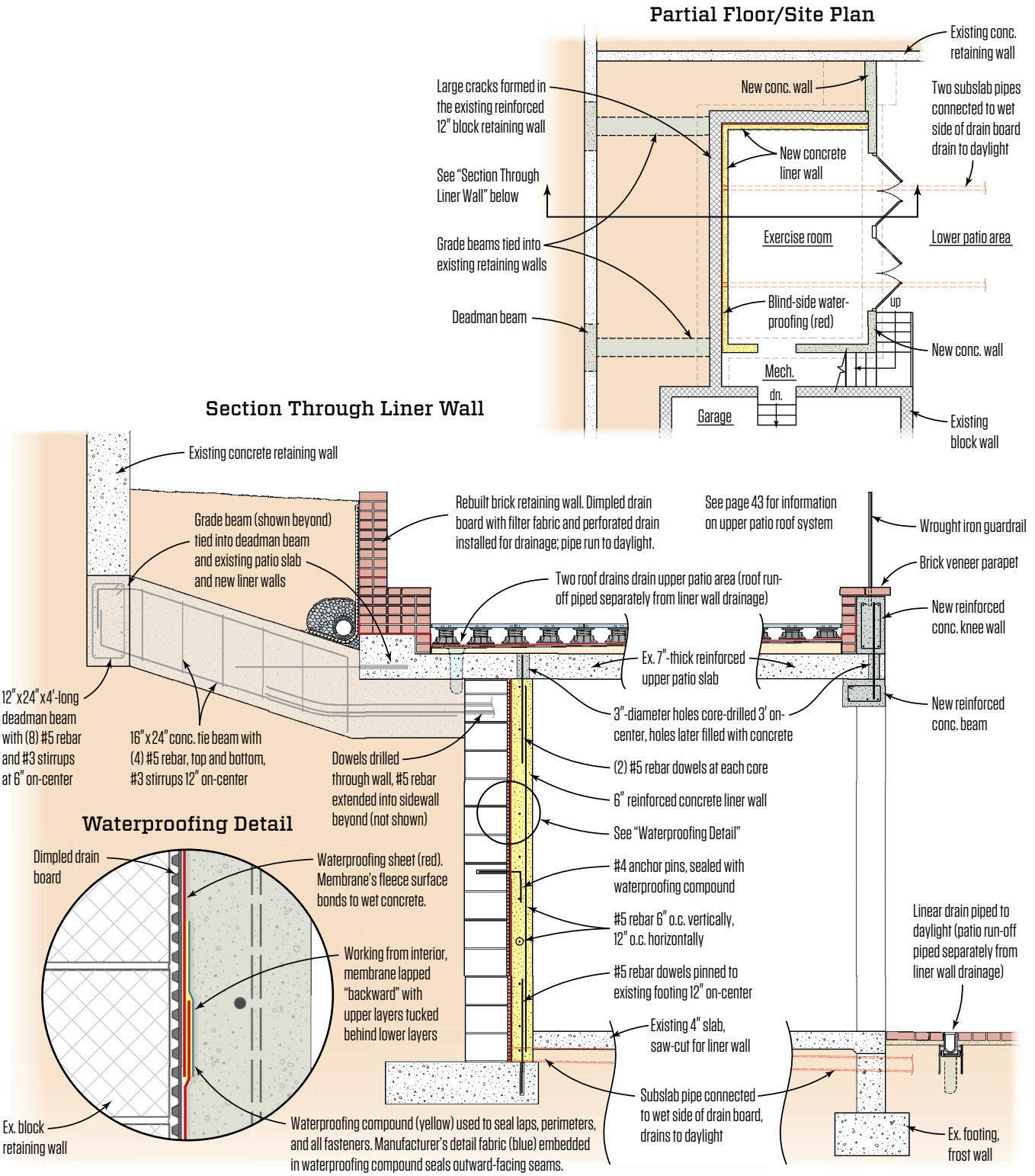
To hold back the weight of the soil and keep the liner walls from being pulled down the slope, the engineer designed two grade beams tied into deadman beams and the liner side walls. The two 4-foot-long deadmen were formed under an existing concrete retaining wall located farther up the hill in order to hold the deadmen in place to prevent their overturning.

"Blind side" waterproofing. On initial inspection, we could see water had been coming through the block walls, and we knew we'd need to manage that water. But our new concrete walls were going to be poured right up against the existing CMU walls, so we would not be able to spray waterproofing on the concrete or install drain board after the pour. It was a perfect opportunity for pre-applied waterproofing.

We worked with our masonry and concrete contractor, AB Construction and Remodeling, which had

The front façade of the attached masonry structure built into the hill is shown prior to the project, its stucco cladding cracked **(1)**. The top of the front wall was pushed outward roughly 2 inches by an underlying slab—seen here during the demolition of the upper patio **(2)**—which had slowly slid downhill over the years.

With termite-damaged framing and moldy drywall removed, cracked and leaky block retaining walls were revealed in the interior. Rusted-out electrical conduit and HVAC line sets were also sources of leaking **(3)**.


Partial Floor/Site Plan
Existing conc. retaining wall
Large cracks formed in the existing reinforced 12" block retaining wall
New conc. wall
Two subslab pipes connected to wet side of drain board drain to daylight
New concrete liner wall
See "Section Through Liner Wall" below
Exercise room
Lower patio area
Grade beams tied into existing retaining walls
Blind-side water-proofing (red)
up
Deadman beam
New conc. wall
Mech.
dn.
Garage
Existing block wall
Section Through Liner Wall
Existing concrete retaining wall
Rebuilt brick retaining wall. Dimpled drain board with filter fabric and perforated drain installed for drainage; pipe run to daylight.
See page 43 for information on upper patio roof system
Wrought iron guardrail
Grade beam (shown beyond) tied into deadman beam and existing patio slab and new liner walls
Brick veneer parapet
Two roof drains drain upper patio area (roof run-off piped separately from liner wall drainage)
New reinforced conc. knee wall
Ex. 7"-thick reinforced upper patio slab
12"x24"x4'-long deadman beam with (8) #5 rebar and #3 stirrups at 6" on-center
3"-diameter holes core-drilled 3' on-center, holes later filled with concrete
New reinforced conc. beam
16"x24" conc. tie beam with (4) #5 rebar, top and bottom, #3 stirrups 12" on-center
Dowels drilled through wall, #5 rebar extended into sidewall beyond (not shown)
(2) #5 rebar dowels at each core
6" reinforced concrete liner wall
See "Waterproofing Detail"
Waterproofing Detail
Dimpled drain board
Waterproofing sheet (red). Membrane's fleece surface bonds to wet concrete.
#4 anchor pins, sealed with waterproofing compound
#5 rebar 6" o.c. vertically, 12" o.c. horizontally
Linear drain piped to daylight (patio run-off piped separately from liner wall drainage)
Working from interior, membrane lapped "backward" with upper layers tucked behind lower layers
#5 rebar dowels pinned to existing footing 12" on-center
Existing 4" slab, saw-cut for liner wall
Subslab pipe connected to wet side of drain board, drains to daylight
Ex. footing, frost wall
Ex. block retaining wall
Waterproofing compound (yellow) used to seal laps, perimeters, and all fasteners. Manufacturer's detail fabric (blue) embedded in waterproofing compound seals outward-facing seams.

a preferred system and supplier for the waterproofing. It recommended WR Meadow's (wrmeadows.com) Precon sheet material, Mel-Drain dimple sheet drain board, and Hydralastic 836 cold-applied waterproofing compound, which work together as a system.

There are two primary layers to the system we used: drain board and waterproofing sheet.

We used the same drain board we use on many projects, a dimpled sheet of heavy, semi-rigid plastic that creates a space for water to easily move down through. We faced the dimple side out in this case, toward the block walls, making a 3/8-inch space at the face of the CMU. The Mel-Drain dimple sheet is available with or without a filter fabric facing, and for this application, we opted to use it unfaced (we use the fabric version only when dirt will be against it, as on the outside of the walls, but in this application, it was sandwiched between two masonry walls).

Installation is a little confusing because unlike when we waterproof on the outside, overlaps tuck the upper material behind the lower—the opposite of what we're used to. The material was pinned in place with powder-actuated fasteners. At the bottom, we placed two PVC drainpipes from the rear drainage space, through the future poured wall. We connected drains later for water to move out of the building to daylight.

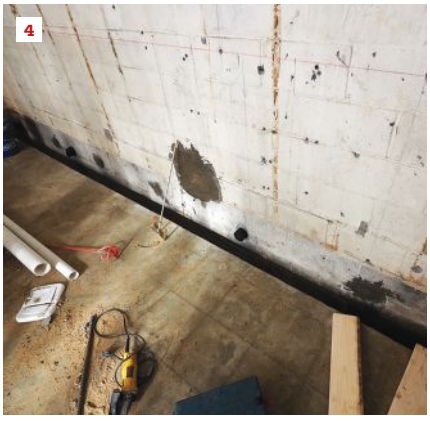
The second layer is the special sheet waterproofing material, designed to adhere firmly to the concrete we poured up against it. We lapped and sealed it as it ran up the wall, again lapping "backward" with upper layers tucked behind lower layers, directing water out toward the block side of the future poured wall.

We again used powder-actuated fasteners to attach it temporarily and used the manufacturer's trowel-on Hydralastic 836 detail material to seal all the fasteners, laps, and perimeter. The Precon waterproofing we used has a fleece skin that wet concrete will bond with, so once we poured the walls up against the sheets, the temporary fasteners were no longer important for holding the waterproofing in place.

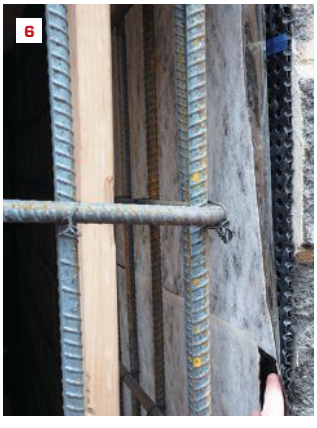
Following the directions wasn't difficult, and the tech support reps for the system were available for questions and instructions. They even offered to come on site, but in the end, we worked remotely with photos and video apps.

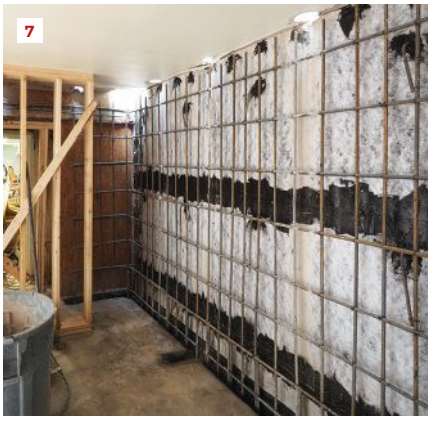
To seal the outward-facing seams, we embedded a strip of the manufacturer's detail fabric in the Hydralastic 836 waterproofing compound; this nonwoven, geotextile fabric helped to create a water- and vapor-proof barrier to resist moisture penetration through end laps.

Concrete "liner" wall. For the 6-inch-thick concrete liner wall, we installed the required rebar in front of the waterproofing, then formwork inboard of that.

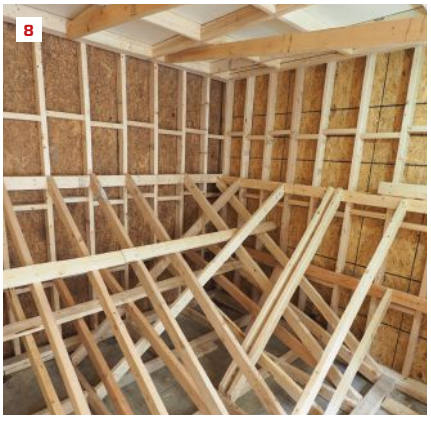


At the slab-to-wall juncture, the existing slab was saw-cut in order to lock in the bottom of the new heavily-reinforced concrete "liner" wall **(4)**. The cut edge also allows room to drain the wet side of the drain board to daylight via two sub-slab PVC drainpipes (see section illustration, facing page).





From the interior, the dimpled drain board is installed first, then the waterproofing sheet. All seam laps, perimeter edges, and fasteners through the waterproofing membrane are sealed with a waterproofing compound. The rebar grid is then installed, tied into the upper patio's slab with rebar dowels through holes cored into the slab, and, at the bottom, doweled into the block wall's existing footing **(5–7)**.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9

Due to the nonstandard wall height, custom single-sided formwork was built on site **(8)**. The liner walls are poured through cored access holes through the upper patio slab using a 3-inch hose with pea-stone gravel mix to facilitate flow in the rebar-filled cavities **(9)**.


10


11

With the forms stripped, the interior space is ready to be fitted out **(10)**. For the stairs to work correctly at the upper patio, a new landing was poured; the existing slab was cut away to fit in the additional riser **(11)**.


12

The masonry walls and ceiling were furred out with steel studs to run wiring and lighting, while the front wall was framed out with 2-by stock to more easily frame the rough openings for the arch-top doors **(12)**.

The engineer had cleverly called for holes to be drilled 3-feet on-center in the existing upper patio's 7-inch-thick concrete slab, so we had easy access to pour the concrete from the top of the wall.

The pour was accomplished with a 3-inch hose, trailer-mounted concrete pump, and a site-mix concrete truck with pea-stone gravel to facilitate flow in the rebar-filled cavities of our new liner wall (as shown in the photo on page 38 and photo 9, left). We filled the drilled holes through the ceiling slab with the same concrete from the wall pour and later waterproofed the top of the ceiling slab. (See facing page for information on the upper patio roof system.)

Additional concrete work. The structure's downhill "front" wall was also in poor shape. In addition, the clients wanted to change the style of exterior doors from sliders to a set of arch-top double doors, so we removed all the concrete block on the fourth side of the structure. We poured a reinforced concrete knee wall on top of the upper patio slab to support a new brick-veneer parapet and poured a reinforced concrete beam below the slab to square up the opening. (The door's arch-top rough openings were later framed out with 2-by stock and a stucco finish was applied to the front façade).

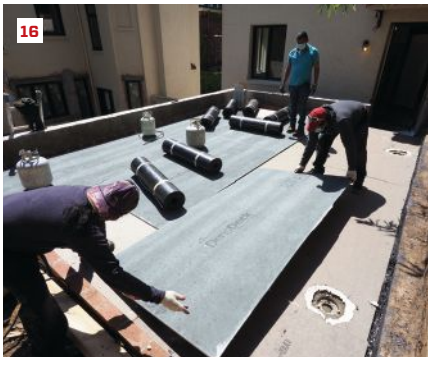
Blind-side drainage. Our last task was to connect the drainpipes we installed through the wall to an acceptable outlet for any water that comes down the wall. We had left the existing floor slab in place; it made for easier working compared with gravel or mud, and, in fact, we attached the wall formwork to it. Following the plan created by the engineer, we channeled across the slab in two places, exposing the two 3-inch PVC pipes we had cast into the wall. These connected the wet side of the drain board to the below-slab gravel area; we tied new pipes to them to run out the front side of the building and out to the surface as the grade drops off.

There are a number of pre-applied waterproofing materials that can be built into relatively simple systems (like our two-layer system here) or more complex ones (with multiple layers, lots of detail work where there are penetrations, and so on). Chances are, there are engineers, material suppliers, and contractors in your area who are familiar with the local geology and workforce and can recommend the right system for your conditions.

Our system was relatively simple to install, and we had good support when we had questions or issues during the work. It has held up to heavy storms over the two years since we installed it.

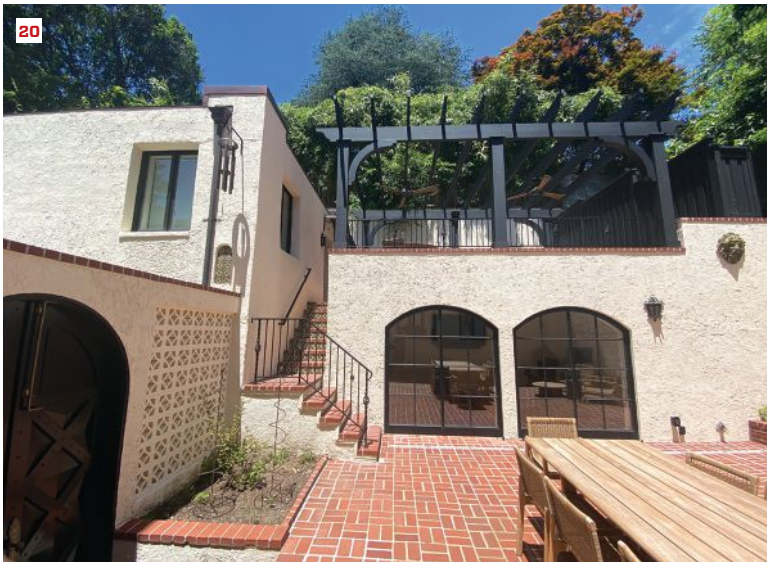
Doug Horgan is vice president of best practices at BOWA, a design/build remodeling company in McLean and Middleburg, Va.

At the upper patio area, a reinforced deadman beam is formed under an existing concrete retaining wall to help hold the deadman in place and prevent it from overturning **(13)**. Access holes are cored into the existing slab **(14)** and rebar dowels are pulled through the holes and set in concrete **(15)**; the rebar is cut flush with the slab later.



Over a slope-kit of polyiso foam that makes a 1/4-inch-per-foot slope, the crew installs gypsum roof underlayment in the roof drain area **(16)**. The previous roof was asphalt; a torch-down roof system is installed to avoid any compatibility issues with asphalt and single-ply systems **(17)**. New patio tile is installed on adjustable-height pedestals over a protection board **(18)**.

A linear drain (in the background) is being installed in front of the pair of arch-top doors, outside the new exercise room **(19)**. The completed project **(20)**.



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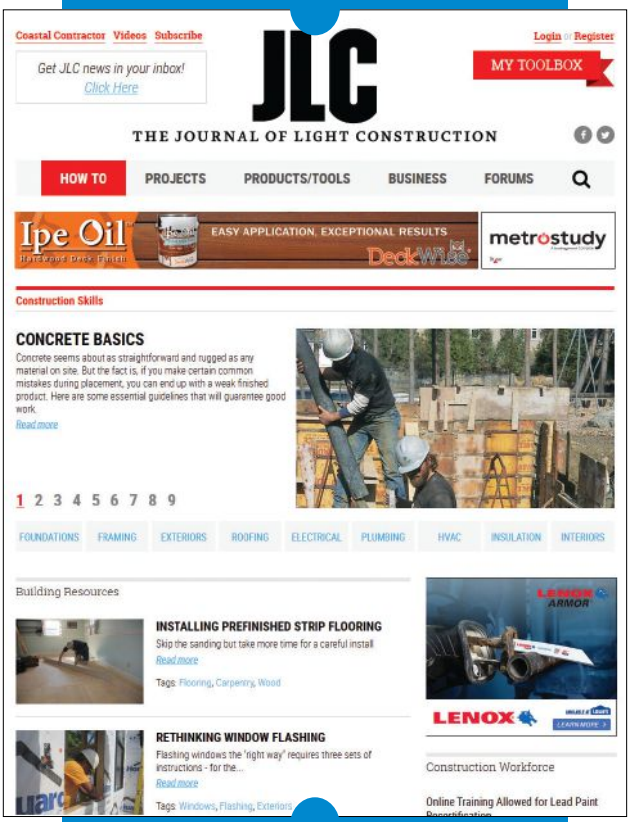

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Installing PVC-Type Sidings in Cold Climates

Beware of impermeable sidings without vented rainscreens

BY GEORGE TSONGAS

In a recent advertorial that appeared on *JLC*'s website, the author exclaims the virtues of solid PVC siding and trim, including "not having to add a rainscreen." Yet the lack of a rainscreen (or enough continuous exterior insulation) with any polymer-base siding (including vinyl, "solid" PVC, and similar materials that are not vapor permeable) in residences can potentially cause serious and widespread moisture damage to wall sheathing and framing.

It has long been known that water vapor produced indoors can migrate by air leakage or vapor diffusion into walls and condense on the wood sheathing or the exterior portions of framing in cold climates. That commonly and naturally happens during wintry weather. During winter, the moisture content in sheathing rises and peaks, and eventually falls again with warmer spring and summer weather. The key is that wood or similar siding or fiber-cement siding is vapor permeable (what some call "breathable") and allows moisture in the sheathing to slowly but surely dry to the outside air. If it dries enough, the sheathing moisture content drops below the fiber saturation level of about 26% to 30%. Below this level, decay cannot occur during warm spring and summer weather.

It is important to note that decay occurs only when wood is both wet and warm for extended periods of time. The optimal temperature range for the growth of decay fungi is about 65°F to 95°F (18°C to 35°C). There is little or no growth below 50°F (10°C).

Photos by George Tsongas

The effects of trapped water vapor. These walls **(1, 2)** on single-family homes in northern Wisconsin had been covered with a weather-resistive barrier (WRB) that acted as a vapor barrier. Moisture-laden indoor air migrated toward the outdoors by air leakage and vapor drive and condensed on the back of the sheathing, leading to extensive rot.

It also has been known since the 1950s or so that in cold climates, the vapor permeability of exterior cladding must be much greater than the permeability of the interior surfaces of the wall to allow indoor water vapor that enters a wall cavity to dry to the outdoors. That means that the outside cladding system must be vapor permeable. However, siding materials like cellular PVC, poly-ash, metal (steel or aluminum), and vinyl are not vapor permeable. They may act like vapor barriers on the wrong side of the wall. In such cases, the water vapor that enters the wall cavity from indoors and condenses in the sheathing and framing leads to much higher sheathing moisture contents (higher, that is, than in walls with vapor-permeable siding materials) and cannot dry out as easily during warm weather when decay can occur. Thus, it is possible that the sheathing moisture content will remain above the fiber saturation level well into warm weather and lead to decay of sheathing and framing. Mold growth inside the wall cavity is also possible, along with deterioration of WRBs.

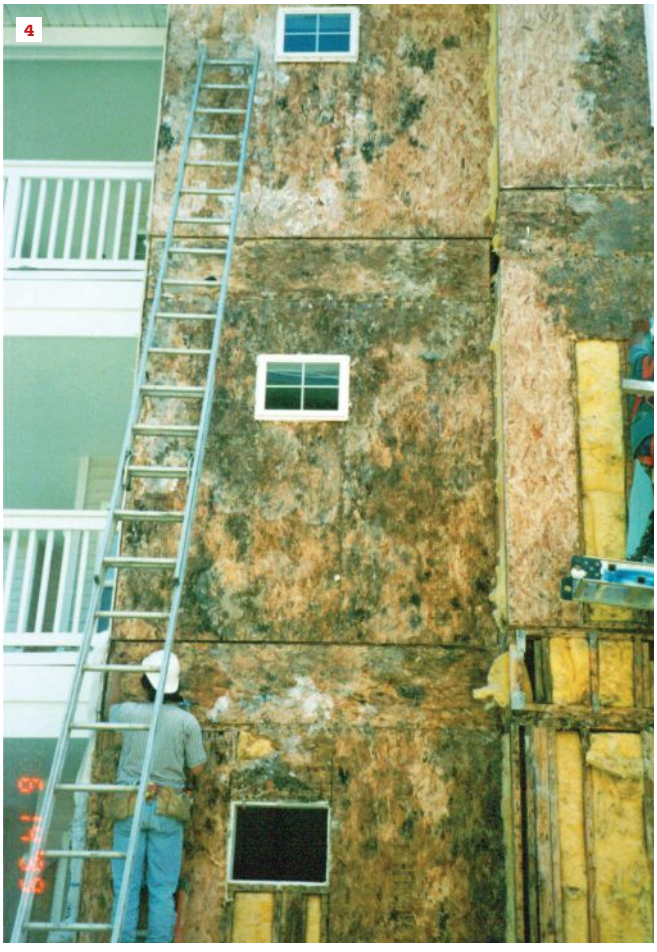
Whether or not the sheathing and framing get wet enough to cause moisture damage depends on several factors. Interior vapor barriers can reduce the amount of water vapor entering wall cavities, but in practice, it is hard to keep all interior moisture from entering walls given the myriad ways air and water vapor can enter them.

One key is to keep the relative humidity of the interior air low. This will minimize the moisture load that is driven into walls. Most damage in walls has been found to be in walls adjacent to bedrooms where relative humidities are typically higher than in other indoor locations. Oftentimes, indoor ventilation, especially in bedrooms, does not keep indoor relative humidities low enough to prevent damage in walls.

MULTIFAMILY VS. SINGLE-FAMILY HOMES

A critical distinction should be made between multifamily and single-family walls. Single-family homes lose moisture that is generated indoors through four (or more) walls. A unit in multifamily housing, however, loses indoor moisture through many fewer walls—often just one or two. So the moisture load in multifamily walls is much greater than in single-family walls. Wall-cavity moisture problems, especially vapor-drive problems, are more likely to occur in multifamily housing walls. That said, there is a real potential for similar problems in single-family housing in cold climates, especially in very cold climates, as well as in homes that are very airtight and underventilated and thus have elevated indoor relative humidities and higher dew point temperatures. As all housing gets tighter via new codes, the problems may only grow worse. That is not to say we need to stop tightening houses. Rather, we need to alleviate the resulting moisture loads with effective ventilation and condensation control in walls.

I saw an example of what can happen when single-family walls are installed with a vapor barrier on the outside of the wall cavity



Increased moisture loads. Inspections of multifamily housing in Oregon revealed water staining on gypsum sheathing beneath contact-applied vinyl siding **(3)**, and serious decay and mold damage on the OSB sheathing beneath the gypsum **(4)**. With fewer walls facing the exterior in multifamily units, moisture loads driven by air leakage through those walls tend to be higher than in single-family homes, where an equivalent moisture load may be driven through walls on all sides.

when I had the opportunity to remove all the hardboard siding from 15 single-family homes in Wisconsin (climate zones 6 and 7) that mistakenly had a low-permeability (0.6 perms measured) exterior water-resistive barrier (WRB) installed. This WRB had trapped moisture coming from indoors in the plywood sheathing. Inspections prior to mine had found widespread sheathing damage in hundreds of these homes. Fourteen of the 15 homes I inspected had plywood decay, with 12 severe enough that the plywood could easily be torn apart by hand. We determined that the extensive and widespread damage (see examples in photos 1 and 2, facing page) was caused by vapor diffusion and air leakage from indoors rather than from rain leakage from the outside of the wall cavities. None of the outside surfaces of the siding exhibited any signs of water damage.

While this example involved an impermeable WRB, it demonstrates the condensation potential from trapped moisture in single-family homes in very cold climates. As we shall see, it's plausible that similar damage can be expected with impermeable siding materials, even vinyl siding (contrary to widely held beliefs), in cold winter climates.

Here's an example of what can happen in multifamily housing with impermeable siding that acts as an exterior vapor barrier. I was present at site inspections in which we opened up walls at seven, mostly large multifamily housing complexes in Oregon and Washington. These housing complexes in a relatively mild marine climate zone each included numerous buildings, and dozens to hundreds of apartments, with vinyl siding. None of the exterior walls had a rainscreen or exterior insulation (a condition I call "contact-applied" siding).


5


6

On a multifamily housing complex in Washington state, removal of contact-applied vinyl siding, paper, and gypsum sheathing revealed moldy, decayed OSB **(5)**. The damage was worse on the inside face of the OSB. On a different housing complex in Oregon **(6)**, moisture driven from the interior caused sporadic deterioration of the WRB and decay of OSB sheathing.

Most people believe that walls clad with contact-applied vinyl siding work well because the siding is applied "loose" and reportedly "drains well." However, in every one of those seven cases, most of the buildings had some damage to wall components behind the vinyl siding, and there was no evidence of excessive rainwater intrusion or construction defects that would have led to rainwater intrusion. Rather, the damage, which included WRB deterioration, mold, and serious decay of the plywood and OSB sheathings and wall framing, was found to be directly related to water-vapor transport into the wall cavities from indoors. Oftentimes, the back face of the vinyl siding was dripping wet (see the photo on page 33).

Observations at the wall-opening inspections revealed that OSB decay was surprisingly widespread, but it occurred sporadically. Not all wall areas were affected. It occurred mostly on north-facing walls and seldom on warmer, south-facing walls; often at intersections of interior walls; and in some cases, between floors where air leakage typically was highest. The sheathing was routinely wettest on the inside faces, indicating moisture was coming from indoors. In addition, the sheathing and WRB damage (including decay, mold growth, and WRB deterioration) and elevated moisture contents, as well as elevated indoor air relative humidity and dew points, correlated in most cases to bedroom walls. Notably, there was very little indoor mold observed, although the wall damage did not appear to be related to lack of sufficient indoor ventilation. The photos above and on the facing page are typical of the sheathing decay and housewrap deterioration we found at the wall-opening inspections.

POTENTIAL FOR WIDESPREAD PROBLEMS

Mold and decay problems inside wall cavities with vinyl siding are not widely known, since not much vinyl siding gets removed and wall cavities behind it are seldom inspected. As a further verification of this problem, WUFI modeling (using software that evaluates vapor diffusion and moisture transport through building materials) in one case compared OSB sheathing moisture contents behind vapor-impermeable vinyl siding and vapor-permeable fiber-cement siding. OSB moisture contents with fiber-cement siding remained well below levels that allow decay, whereas the OSB with vinyl siding reached moisture contents well above levels that allow decay. Those modeling results would be the same for single-family walls, as well. It is important to note that, while not widely known, decay can produce significant strength loss even when it is barely visible. Substantial visible decay of plywood and OSB structural sheathing was often observed. So, while not studied, it appears possible that some walls with contact-applied vinyl siding or any other impermeable cladding could be at risk of structural failure, which is an obvious life-safety concern.

TWO WAYS TO AVOID PROBLEMS

To avoid these problems, contractors have two clear choices: Add continuous exterior insulation that warms the sheathing and

considerably reduces condensation, or use a rainscreen with a WRB. Choosing exterior insulation reduces wall heat loss while avoiding wall damage, but at the greatest cost. You must use enough continuous insulation; too little continuous insulation over cavity-insulated walls is risky (see "Avoiding Wet Walls," Apr/17). With the rainscreen choice, the key is not only preventing damage to sheathing and framing from condensation, but also allowing water that may leak to the back face of the siding to drain out of the wall and dry.

WRB effectiveness. A laboratory study I conducted for a major supplier of wall WRBs tested the relative performance of walls with a regular, flat WRB, a crinkled WRB, and a rainscreen (with an air gap and a flat WRB). We tested each under wall leakage conditions where water was leaked into the tops of the wall cavities between the back of fiber-cement siding and the outside of the WRBs for four months. At the end of the test, the sheathing was very wet, moldy, and decayed on the wall with the flat WRB; somewhat less wet and moldy with no decay with the crinkled WRB; and completely dry and without mold or decay on the wall with the rainscreen. Many contractors are now selecting crinkled or other "drainable" WRBs, but that is not sufficient to prevent damage in walls with impermeable siding. The only prudent choice is to employ a rainscreen design to prevent major damage to walls with impermeable siding.

BOTTOM LINE

The point of all this is that walls with impermeable siding—including conventional vinyl as well as solid, or "cellular," PVC or polymer-based materials—definitely need to have a fully top- and bottom-vented rainscreen, or sufficiently thick continuous insulation, behind the siding. The fully vented rainscreen allows interior moisture to dry out, while exterior insulation warms the sheathing. In both cases, condensation-related elevated moisture contents are kept to a minimum. Choosing to "not add a rainscreen," or not include continuous insulation, can potentially cause serious and widespread moisture damage to wall sheathing and framing. Is the cost savings worth the risk?

Details of many of the research findings and other pertinent information can be found in my article "Cautionary Case Studies: Damage in Multifamily Housing Walls with Vinyl Siding" (*ASHRAE Journal*, July 2017; ashrae.org).

George Tsongas is a consulting engineer, building scientist with specialization in moisture problems in buildings, and professor emeritus of mechanical engineering at Portland State University, Portland, Ore.

On the walls of the same Oregon housing complex shown on the facing page, deterioration of the OSB and WRB occurred sporadically, but the worst damage correlated with bedrooms with high indoor air dew-point temperatures. Note the green pen knife, which easily penetrated the OSB **(7)**. A similar condition was found in a wall beneath vertical board-and batten-style vinyl siding **(8)**.

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PHOTO BY MICHAEL WALTER


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Dropping the Deck Ledger

by Glenn Mathewson

When we first began building residential decks, there was no scientific research that determined we should use ledgers, joists, beams, and posts the way we did. It just happened that we'd want a deck to be about the same level as the home's first floor, and connecting a ledger to the band joist, with deck joists hangered from its side, seemed to make sense—until it didn't.

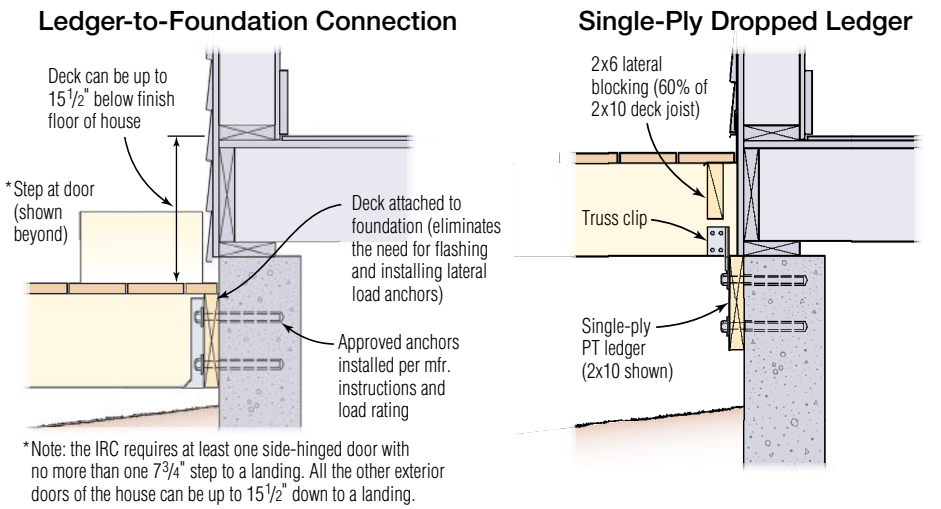
As problems started to crop up with some of our ad hoc ledger connections, researchers and code officials began to pay closer attention to these details. As a result, now we know better than to fasten a ledger over existing exterior cladding or veneer; you've got to cut through the cladding to the framing. The ledger flashing can't be stuffed up behind the siding; no, it has to be laced in shiplap-style with the water-resistive barrier. And no longer is it acceptable to drive lag screws through the ledger into the wall and "call it good" when they snug up. Now, the IRC has strict guidance for spacing between fasteners and edge clearances. And whether you use bolts or lag screws to fasten the ledger to the framing, the inside of the band joist must be accessible to either thread a nut or verify what the lag screw is holding. What about anchored brick veneer, stucco, or adhered stone—how do we get around that? Here's where we lower our sights—to the foundation instead of the band joist.

One or two steps down. For ground-level decks, the foundation just below the wood framing is attractive for connection. There's no cladding, no flashing to lace with the WRB, no need to open up floor framing to see what's inside. The IRC doesn't provide a fastening schedule for attaching a ledger to a concrete foundation, but with a little data from the hardware manufacturer, it's not hard to figure out. In many designs, two steps from a back door or a landing with steps is an easy way to bring the occupants down to this slightly lower deck level while avoiding the hassles of a ledger connection to wood framing.

Dropping the ledger. But what if the owner doesn't want the deck dropped down from the interior floor? Can we drop the ledger instead, like we drop beams?

The answer can be found in the IRC. Typically, we think of deck loads being carried down from the joists to the ground through a ledger on one side and a beam or rim joist on the other. To transfer these loads, Section R507.6.1 in the 2021 IRC requires a minimum of 1½ inches of bearing on wood or metal. We generally think of this as bearing on top of a beam or in the saddle of a hanger, but a ledger provides 1½ inches of bearing surface as well. The section also describes fastening methods intended to prevent joists from rotating: *Joists bearing on top of a multiple-ply beam or ledger shall be fastened in accordance with Table R602.3(1). Joists bearing on top of a single-ply beam or ledger shall be attached by a mechanical connector.*

I think this is a subtle but solid nod to the idea of supporting joists on top of a ledger. A single member below, such as a single-ply beam or typical ledger, is large enough for the bearing surface but isn't practical for angled and often haphazardly installed toenails to fully engage. For this reason, mechanical connectors, such as truss clips, are required. It's



A step (or two) down to the deck is usually needed when a deck ledger is anchored to a concrete foundation rather than to the house framing (far left). Instead of hanging the deck joists from the ledger, installing them so that they bear on the ledger (like a dropped beam) allows the deck to be flush with the house floor framing (left).

ILLUSTRATIONS BY TIM HEALEY

important to note there is no magnitude of load resistance called out for these connectors, and that's not an oversight. These connections are intended to prevent joists from moving laterally and are not intended to resist any lateral live loads generated by occupants or wind, nor any uplift loads. This is no different from hangers connecting joists to the side of a ledger or beam; hangers are also designed only to transmit vertical loads and to resist joist rotation. The face nails through the hanger are not designed to resist lateral live loads any more than toenails or truss clips.

When a home's sheathing and cladding extend out over the foundation wall enough that a double-ply ledger is required to provide enough bearing for the joists, are there any issues in anchoring both ledger layers to the foundation at the same time? That is a trickier question, and the code doesn't provide an answer. This would depend on the concrete anchor and how its load rating is determined. An anchor going through both ledger plies will ultimately stick farther out of the concrete and take a load 3 inches, rather than 1½ inches, away. This "technically" puts more torque (moment) on the anchor. That said, I would not be worried about it. This is another example where the code provision would be stretched a bit and would require review by a knowledgable and rational building inspector. A two-ply member (beam or doubled-up ledger) has sufficient material to connect to via the 2021 IRC's Table R602.3.1, which calls for nothing more than three toenails.

Brick veneer is a common cladding in my area and is typically installed flush with the foundation wall on top of a brick ledge cast into the foundation. As long as the brick doesn't extend down to grade, a single-ply ledger can simply be anchored to the foundation wall.

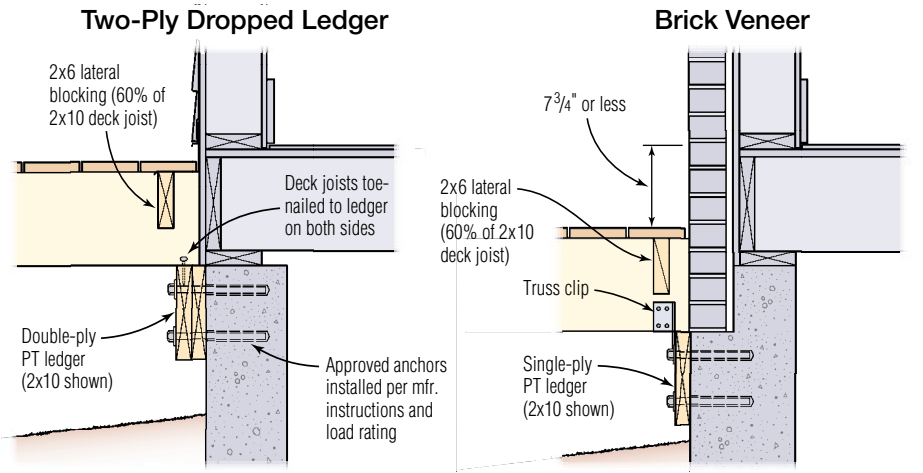
Sometimes the brick veneer extends below grade. In these cases, no one really knows what is behind the veneer and where the top of the concrete or masonry is located. Anchors have specific installation requirements with edge distances and concrete vs. masonry (CMU). You can't install anchors through the brick veneer. In these cases, I would not recommend attachment through the brick to the foundation.

Lateral loads. Section R507.6.2 is titled "Deck joist lateral restraint," but don't confuse this with the connections we just discussed or lateral live-load design methods. This section is about joist rotation, and as mentioned, hangers provide this restraint. Without hangers in a dropped ledger design, blocking is necessary between the joists, but it must be only 60% or more of the height. So 2x6 blocks work for 2x10 joists, while 2x12 joists would require 2x8 blocking. Though not stated in the code, the blocks don't have to be directly above the ledger. They could be a few inches away from the ledger and exterior wall to allow for drainage and ventilation. The fewer materials sandwiched against each other in deck construction, the better.

For lateral load design, nothing about a dropped ledger precludes the use of either lateral-load-anchor method provided in the IRC. The point of these connections is to be independent of the ledger. A dropped ledger is most advantageous for ground-level decks and attaching to the foundation, so bracing between the posts is also effective for lateral load restraint, likely eliminating the need for the anchors into the house.

With less conventional methods of construction, it's important to analyze each loading fundamental and evaluate whether it's satisfied. For a dropped ledger, we get 1 ½ inches of bearing, we secure the joist in place with clips, we resist joist rotation with blocking, and we recognize lateral live loads are not restrained. We provide lateral-load connectors or other bracing methods. If you think outside of the box, just be sure you've got the same or equivalent contents. ❖

Glenn Mathewson is a consultant and educator with BuildingCode College.com and a frequent presenter at JLC Live.



A double-ply dropped ledger may be required to provide adequate bearing for the ends of the deck joists (far left), but this detail requires careful review of the load ratings for the concrete anchors and inspector approval. When there is brick veneer cladding, anchor the ledger to the foundation below the brick ledge and never to the brick itself (left).

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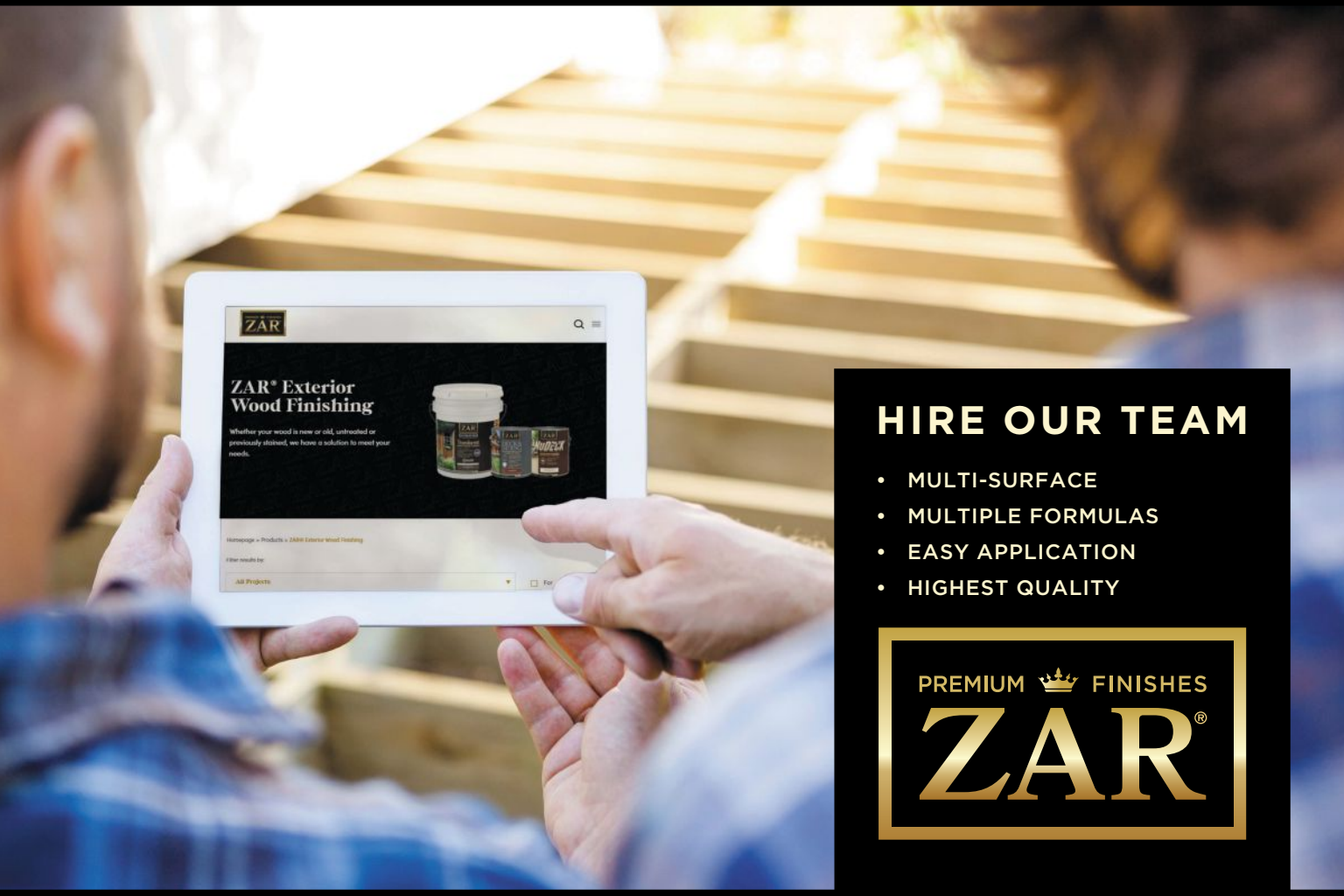

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PHOTOS BY CLEMENS JELLEMA

Rock-Solid Outdoor Kitchen

Wood framing clad with light manufactured stone veneer provides a solid base for stone countertops

by Clemens Jellema

When I began building decks more than 20 years ago, a project that included an outdoor kitchen was a rarity. Now, over half of our deck designs call for a kitchen, often combined with a roof structure like a pergola or pavilion. It's easy to understand why: Like its indoor counterpart, an outdoor kitchen is a welcoming place that brings people together to talk, eat, drink, and socialize while food is being prepared. An outdoor kitchen is also a great investment that is easy to upsell to clients because it will add value to their home (in my area, ROI can be up to 100%).

Design

We work directly with clients to design their kitchen. Most have a hard time visualizing what they are trying to achieve, so the 3D renderings we create using Realtime Landscaping Architect (reviewed in the November/December 2021 issue of *JLC*) are invaluable during the process.

We start with basic requirements—location, size, privacy concerns, sun exposure, view—and then move to appliances. The main components in most of our designs are a built-in grill with storage below, a fridge, and additional storage. Sometimes, clients think they want an outdoor sink too, but after a conversation about the advantages and disadvantages, often they decide that the added convenience is not worth the extra cost. In fact, most of our outdoor kitchens don't include a sink; instead, we install a built-in ice bin.

Once we've settled on a rough layout, I create a preliminary 3D rendering with views from different angles, together with an overhead view showing the dimensions. When the plan has been approved, I fine-tune the rendering by adding outlets and light fixtures and adjusting the stone and granite selection.

After we agree on the cost of the project and the contract is signed, I complete the construction drawings and submit the plans to the county permit office for approval.

Framing Requirements

Sometimes the kitchen will be located at grade over a concrete patio, in which case the enclosure walls can be built with 6-inch CMUs. But when the kitchen will be installed on an elevated deck, we frame

the kitchen with pressure-treated or galvanized steel studs. Even so, the standard 50-pound-per-square-foot design load for an outdoor deck is not sufficient to also support the weight of an outdoor kitchen. Not only do the framing, finishes, and equipment add weight, people tend to gather around this area more.

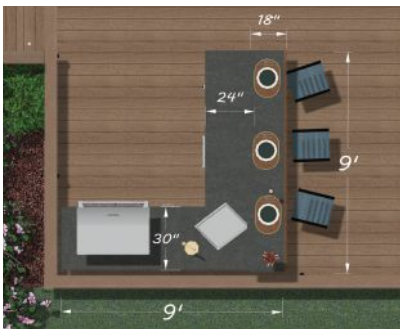
As a rule of thumb, we double the design loads for the tributary area where the kitchen is going to be installed, so that the dead loads are 20 pounds (instead of 10) per square foot and the live loads are 80 pounds (instead of 40) per square foot. As a result, joist and beam spans are reduced, while the size of footings is increased. To make sure the deck will be strong enough, I have the final plans reviewed by an engineer for approval (see floor plan, right).

Before construction of a kitchen can begin, we make sure all appliances that will require a rough opening are on site. This includes things like storage drawers and ice and trash bins, as well. That way, we can lay out the walls confidently, using cardboard templates cut to the rough-opening requirements of each appliance instead of relying on printed specs.

Prior to installing the decking where this kitchen would be located, we covered any doubled joists with 4-inch-wide G-tape acrylic flashing tape to prevent water from pooling between members. We also installed horizontal blocking between the joists where the perimeter walls for the cabinetry would be located.

We framed the kitchen's perimeter walls with pressure treated 2x4 studs 16 inches on-center, and the bar wall with PT 2x6 studs 16 inches on-center, joining the framing together with 3-inch ringshank galvanized nails and 3-inch structural exterior screws.

We framed the counter walls so that the finished height after the stone countertop was added would be 38 inches, rather than the standard 36 inches (I like to think bigger when designing and building outdoor kitchens, both in height and in square footage, to provide extra room for seating, grilling, and dining). We framed the bar wall at 46 inches so that it would be 8 inches higher. We always slope the framing for drainage so that there won't be any standing water on the countertops after a rain shower.



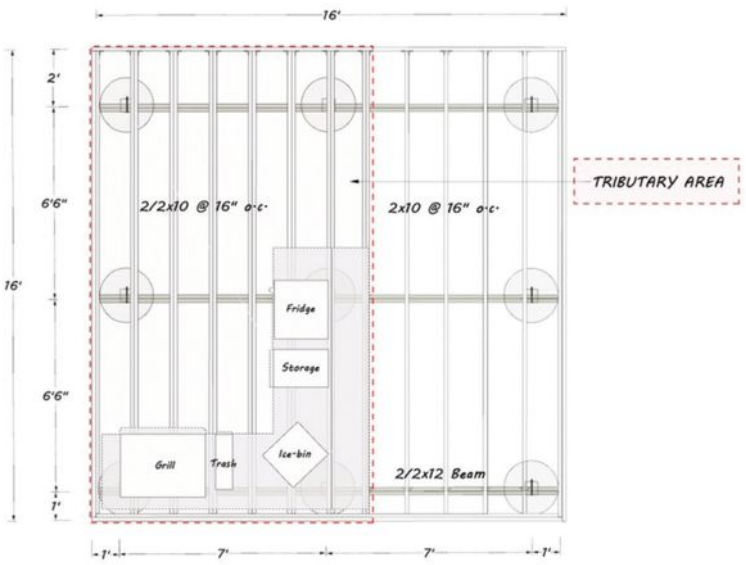


Figure 1. To help his clients visualize the design of their new kitchen, the author used a CAD program to create 3D renderings, including an overhead view with dimensions (left). As shown in the framing plan (below), joists were doubled in the tributary area where the kitchen is located to accommodate the added weight of the kitchen appliances and cabinetry.

After we framed the walls on the deck, we set them in place and made sure they were level and plumb. Then we used 4-inch exterior structural screws to fasten them to the horizontal blocking installed beneath the decking. As we built the walls, we used cardboard templates cut to the rough-opening requirements of each appliance and accessory to make sure everything would fit, making adjustments as needed. This can be done either before or after the perimeter walls are built.

Clearances for appliances are usually specced by the manufacturer, but in general, we plan on at least ¼ inch of space on each side of an appliance. For refrigerators, we leave a clearance of at least ½ inch on each side and 1 inch in the back to maximize ventilation.

Utilities. After all the framing was completed, we scheduled the electrician to do the wiring. We like to include at least one or two outlets at the raised bar and one under the cabinet for a transformer for low-voltage lighting. All the wiring is UF-B outdoor-rated cable, which we secured with stainless steel staples where we didn't run it through conduit.

On this project, we included three low-voltage LED light fixtures under the bar, and six recessed floor lights in the work area. All are connected to the transformer that is plugged into an outlet inside one of the cabinets.

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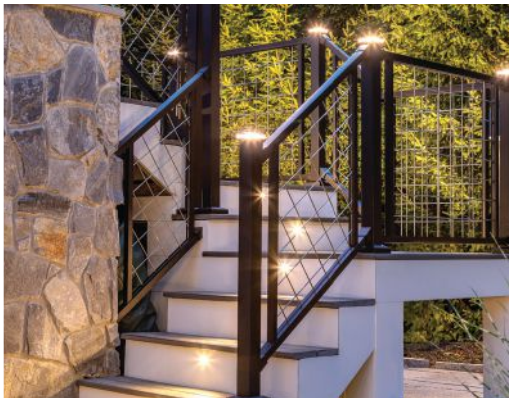

Figure 2. Using cardboard templates sized to fit the appliances (A), workers framed the kitchen's perimeter walls on the deck (B) with pressure-treated 2x4s and 2x6s, then screwed them together and through the decking into blocking installed between the joists (C). The cabinet walls are clad with cement board over a vapor retarder (D).

Figure 3. Masons troweled on a mortar scratch coat over galvanized diamond lath fastened to the cement board (A), then allowed the mortar to cure overnight. When applying the manufactured stone veneer, they started at the corners (B) and worked in sections (C), back-buttering each stone and pressing it into the scratch coat.

Gas grills are typically connected to the main gas line serving the house and need to be installed by a plumber. Fortunately, running the utilities for an outdoor kitchen is pretty straightforward.

Stone-Veneer Finish

To create a substrate for the manufactured-stone-veneer cladding used on this project, we wrapped the framing with ½-inch Durock cement board secured with 1 ½-inch screws 8 inches on-center. When cement board is used over treated framing lumber or plywood, we install a Class III (medium permeability) vapor retarder underneath the cement board, since it will retain moisture if it gets wet. Without the vapor retarder, any lumber next to the cement board will always be damp, especially when a kitchen is not covered by some sort of roofing.

After completing the cement-board installation but prior to installation of the stone veneer, we dry-fit the appliances to make sure they would go in smoothly. Then we removed them and put them in a safe area where we knew they wouldn't

JLC INTEL

Barrette OUTDOOR LIVING

EVOLUTION OF THE NEW BACK YARD

How composite decking has played a key role in bringing newfound visions of creative outdoor living spaces to life.

If the past two years have shown us anything, it's how adaptable we can be when faced with the unimaginable. Countless stories have been told about the ways businesses have shifted, families found creative ways to gather, kids found new ways of learning and how homeowners redefined the spaces in which they lived.

In the outdoor products industry, the greatest trend that emerged was a new way of embracing the outdoors as people pushed beyond the four walls of their homes to create unique outdoor living spaces. These spaces created new ways to cook, to entertain, to work, to play and to gather safely—helping boost moods, calm anxiety and providing solace to those who needed it. Leading the way on many outdoor expansions is composite decking—one of many products that are playing a role in helping bring homeowner's outdoor dreams to life.

In the outdoor products industry, the greatest trend that has emerged over the past two years is a new way of embracing the outdoors. Homeowners are pushing beyond their home's four walls, creating unique outdoor living spaces to cook, to entertain, to work, to play and to gather.

WHAT'S TRENDING IN DECK DESIGNS?

Deck design trends are beginning to mirror trends in home-building more closely—moving toward more modern, contemporary styling that showcases clean lines and incorporates railing products that may offer modern mixed material options, such as glass, decorative screen panel or cable infills.

Homeowners are coordinating deck board colors, railing and outdoor décor to create a cohesive aesthetic that tends to blend more seamlessly with outdoor landscapes. A notable increase in color variegation and more realistic wood grain patterns also echo the desire to create a more natural-looking landing space for newly extended areas.

"We've noticed a dramatic increase in homeowners who are looking to expand their outdoor spaces to be more usable areas—some of which are really unique transformations that increase overall quality of life," said Michael Gabso, Owner, MG Construction & Decks. "Installing a composite deck or expanding an existing one is a great way to achieve that extra square footage. We've found the variety of color and patterns found in Barrette Outdoor Living composite decking to be extremely popular amongst our clients."

FRAMING OUTDOOR SPACE AND FOCAL FEATURES

In addition to increasing a home's square footage by adding or extending a deck, unique ways of framing spaces and creating focal features have propelled deck design to a whole new level. For example, installing a pergola can create the illusion of an outdoor room by defining an area and adding height while also providing protection from the elements. Outdoor fire features—fireplaces, fire pits and fire tables—help extend the outdoor living season. And water features are a fun and often affordable way to help bring a sense of tranquility to an outdoor space—adding to an outdoor oasis. A grand staircase or outdoor entertainment center to watch the game or movies also make for great focal features.

Whatever outdoor vision a homeowner may have, Barrette Outdoor Living offers a multitude of outdoor products that can help people embrace their Outside Side, moving beyond the confines of their home's four walls and bringing outdoor spaces to life.

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Figure 4. Workers checked the top of the cabinet surface with straightedges (A) and used a grinder to remove high spots (B) to make sure it was flat prior to installing the granite countertop (C). Ipe trim on the bar overhang (D) offers a warm contrast to the stone veneer cladding (E).

get damaged and called the granite company to schedule a measuring for the stone countertop. On this project, the client chose BoraBora granite, a material that is cost effective (between $35 to $60 per square foot) and available in our area.

Our client chose Eldorado Shadow Rock manufactured stone veneer (in the color Chesapeake) for the cladding, and ipe for the bar top. We installed the stone veneer over a mortar scratch coat and galvanized wire lath, using stainless-steel roofing nails every 6 inches vertically and every 16 inches horizontally to secure the lath to the cement board.

We mixed up the scratch coat using three parts masonry sand, one part Type S mortar, and water. We let the scratch coat dry a full day before starting installation of the veneer stone.

While stone veneer can have mortared joints, on this project the stone was dry stacked, with no mortar between the joints. Starting at the corners, the masons worked in 3-foot-by-3-foot sections, first arranging the stone for each section on a piece of plywood to find an aesthetically pleasing look. They used an angle grinder fitted with a diamond blade wherever a stone needed to be cut to fit or to give it a straight edge around an opening.

To set the stones, they used the same mortar mix as the scratch coat, back-buttering each one and pressing it into the scratch coat until a little bit of the mortar squeezed out.

Countertops

Prior to installing the granite countertop, the installation crew carefully checked the top of the cabinet surface with straightedges to make sure it was completely flat. Where necessary, a grinder was used to remove bumps and high spots to prep for installation.

Granite is heavy and needs to be handled with care, so we rounded up as many workers as we could to help out on the day of delivery. Before lowering the countertop into place, we applied an ASTM C920 silicone sealant around the perimeter.

Finally, we covered the bar overhang with a 1x8 ipe board directly secured through the cement-board substrate into the framing with plugged screws and a dab of PL Premium exterior glue. We drilled 3/8-inch-diameter holes about 1/4 inch deep, followed by 5/32-inch-diameter holes the rest of the way through the wood. After driving the 2-inch exterior screws into the framing, we placed drops of exterior glue into the holes and filled them with 3/8-inch-diameter ipe plugs to give the bar top a finished look. ❖

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Building a 'Removable' Deck

Working around a municipal sewer easement complicated the design

by Michael Walter

Last fall, my company was awarded the contract to upgrade the backyard of a Yorba Linda, Calif., home with a new multilevel 734-square-foot deck. Complicating matters, a portion of the new deck—basically an elevated walkway along the side of the house to the new backyard living area—would be located directly above a municipal sewer pipe and within a 15-foot-wide sewer easement that ran between the house and the property line. For the project to be approved, the city required future access to the pipe in case of trouble and a 5-foot minimum clearance between the pipe and any new deck footings.

To meet these requirements, project engineer Allstar Design & Engineering Group of Orange, Calif., initially designed a cantilevered framing plan for this portion of the deck, with the cantilevered beams partially supported by 4x4 posts bearing on floating 8-inch-thick by 24-inch-square concrete pads. If future access to the pipe became necessary, the engineer designed the pads and posts so that they could be removed without disturbing the deck framing. In the case of a major problem, that entire area of the deck would have to be removed.

While the building and zoning departments approved our plan, the water department nixed the idea of floating pad footings. I wasn't surprised; actually, I was shocked when the city signed off on the initial plan in the first place, so we went back to the engineer to beef up the cantilever design and eliminate the floating footings. Due to the pandemic, we couldn't get any major plan changes through the city in an acceptable amount of time, so we just went with the original drawing but with beefier cantilevers and without the removable pad footings.

Site Work

The existing site plan included a large elevated concrete slab patio off the back of the house, a smaller concrete patio, concrete pathways leading between the front and back of the house, a pair of concrete steps, and a series of CMU planters faced with stone veneer. In some cases, the new deck would incorporate aspects of the original hardscaping; in others, we needed to cut openings in the concrete flatwork to install the formwork for the new piers to support the deck framing. Fortunately, my excavation subcontractor was able to squeeze a small skid steer into the

PHOTOS BY MICHAEL WALTER; ILLUSTRATION BY TIM HEALEY

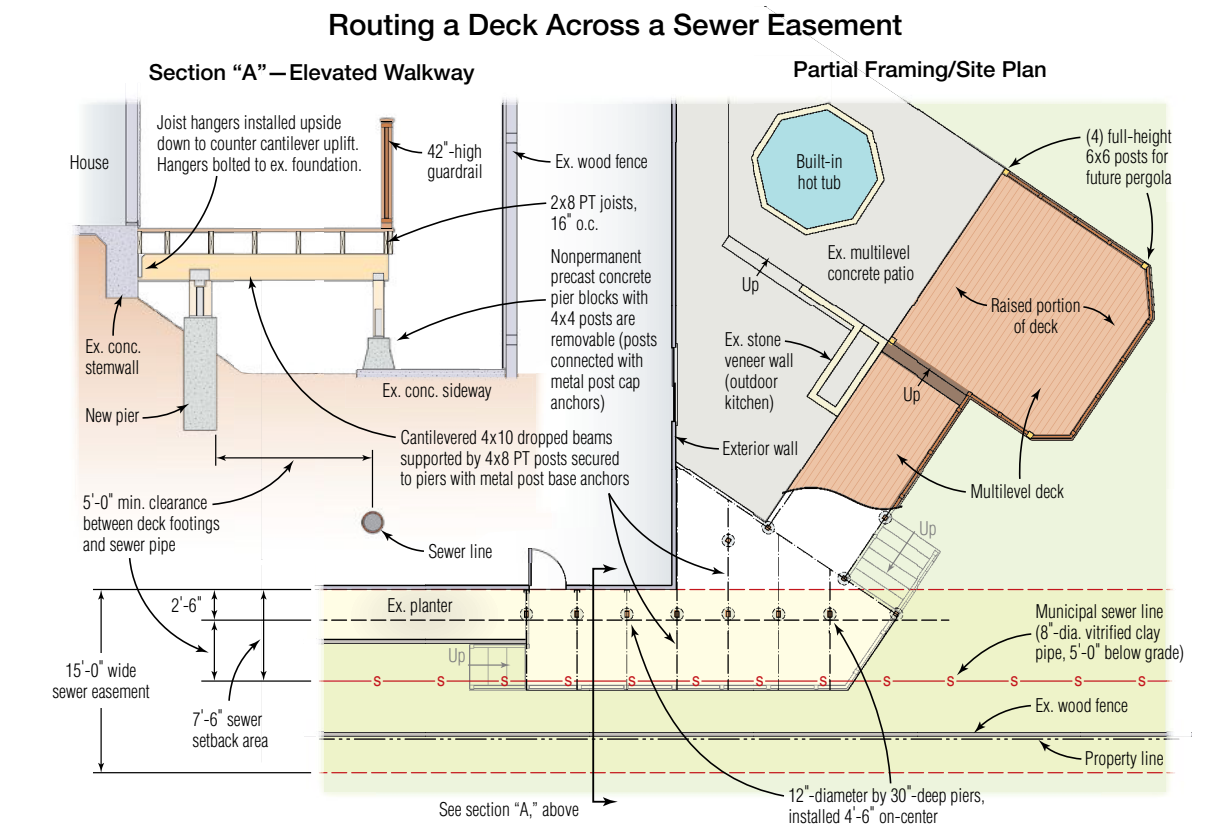

Figure 1. Because of an existing sewer easement (see illustration, above), footings for the elevated walkway along the side of the house could be placed no closer than 5 feet from the municipal sewer line (A, B). Thirty additional piers were also needed to support the main part of the deck, which was designed to extend an existing concrete patio (C).

backyard to do a lot of the grunt work.

To support the framing for the walkway within the sewer setback area, we formed seven 12-inch-diameter by 30-inch-deep piers 4 ½-feet on-center that were located 2 feet 6 inches away from the house wall (maintaining the 5-foot minimum clearance to the sewer pipe). We also formed 30 additional piers to support the 423-square-foot lower deck and the 283-square-foot upper deck in the backyard, ranging in size from 12 inches in diameter and 18 inches deep to 16 inches in diameter and 30 inches deep, depending on loads, soil conditions, and the slope where the footing was located.

We reinforced the deeper piers with tie-wired rebar cages, while the shallower piers were reinforced with rebar grids wired together and sitting on dobbies on the bottom of the form. Prior to pouring the concrete, we suspended Simpson Strong-Tie PBS-type post bases—sized for the post specced for that particular post location—above the form.

After waiting several days for it to stop raining, we finally had a clear weather

Figure 2. The elevated walkway joists are supported by dropped 4x10 cantilevered beams bearing on 4x8 posts (A). At the house, the beams are anchored to the foundation with upside-down joist hangers to counter uplift (B).

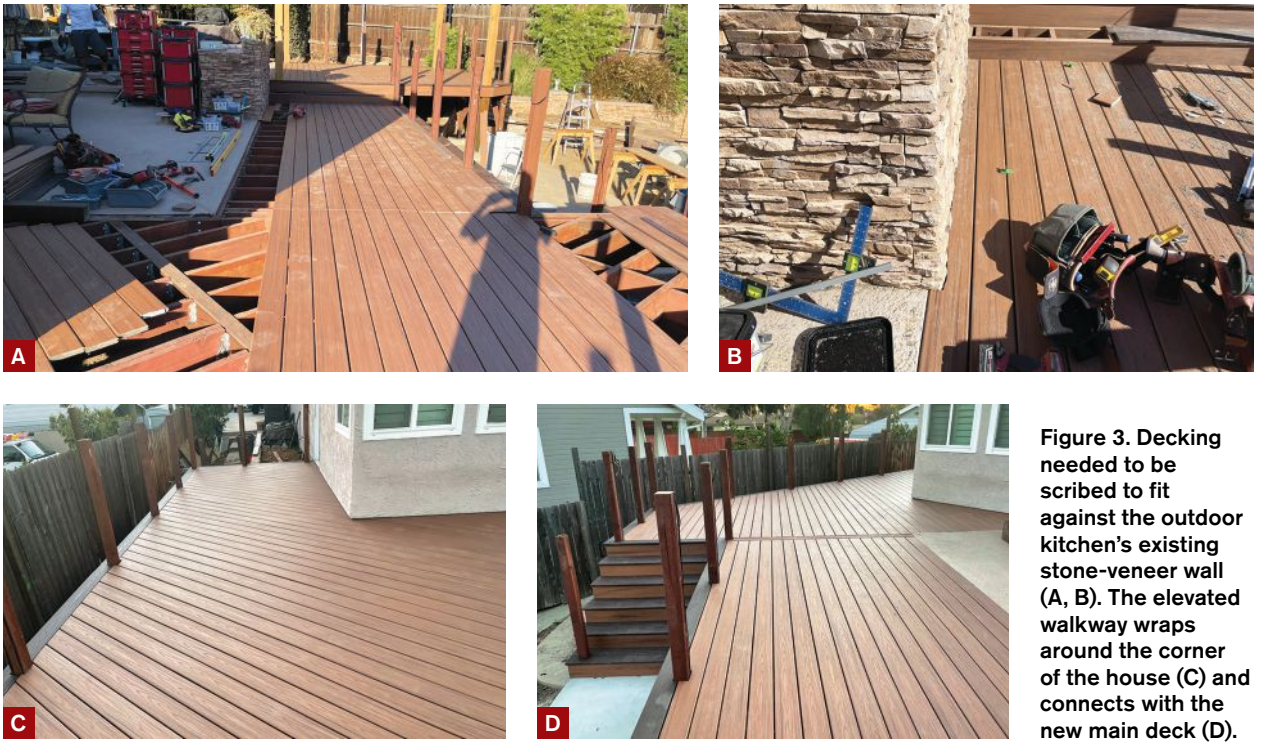

Figure 3. Decking needed to be scribed to fit against the outdoor kitchen's existing stone-veneer wall (A, B). The elevated walkway wraps around the corner of the house (C) and connects with the new main deck (D).

window to pour the footings. We ordered 10 yards of concrete and, since we needed to transport the concrete about 200 feet from the roadway to the backyard, a trailer-mounted line pump. To help prevent a hose blowout in our clients' driveway, I ordered 3,000-psi concrete rather than the 2,500 psi specced on the plans, because the higher-strength concrete here seems to have more "cream" to make it flow better in the hose. It finishes more smoothly and easily, too. The $40 additional fee for the 10 yards was well worth the money.

We were lucky: After we completed the pour, it then rained for the next two days.

Framing

In the walkway over the sewer easement, we installed 4x8 pressure treated posts on top of the piers to support each cantilevered 4x10 dropped beam. The beam ends are connected directly to the house's stem-wall foundation with Simpson Strong-Tie HUC410 joist hangers bolted to the concrete with ¼-inch-diameter by 2 ¾-inch SST Titen screws. To counter the uplift of the cantilever, we fastened the hangers to the foundation wall upside down, per the engineer's detail.

Though the original plans called for diagonal 4x4 braces (which we installed on posts that were more than 36 inches high), the posts in the walkway area were so short that diagonal bracing would have been virtually impossible. Even

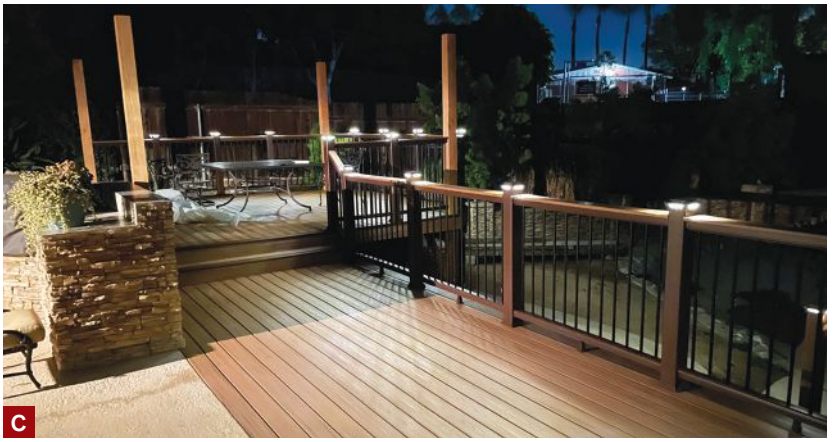

Figure 4. Accessed by a short flight of stairs, the walkway provides floor-level entry into the house and a straight path to the deck from the front of the house (A). As part of the project, the author installed 6x6 corner posts for a planned pergola over the raised portion of the deck (B). Integral post cap lighting helps illuminate the deck at night (C).

without the bracing, however, the cantilevered 4x10 beams were surprisingly stiff and had very little bounce.

For a little peace of mind, I decided to reinforce the cantilevered beams by placing precast concrete pier blocks with 4x4 posts under the end of each one. These supports—which were approved by the inspector—are easily removed if necessary, and the walkway would still be self-supporting without them.

Even though the rest of the deck angles away from the house to fit around the essentially triangular shape of the existing patio, it is conventionally framed with PT 4x8 dropped headers as needed and 2x8 joists to support 60-pound-per-square-foot live loads. In the raised portion of the deck designated for a future pergola, we installed four full-height 6x6 posts on top of the 16-inch-diameter, 30-inch-deep piers; the owners didn't plan to include the pergola in this project, but it made sense to have the footing approval and inspection in hand.

Finishes

Though the original design called for TimberTech decking, our clients preferred the color palette of the Trex Transcend line, and we installed its "tiki torch" composite decking with a "lava rock" border using Camo Edge Clip hidden fasteners and Camo's stand-up Clip Drive driver. This was one of the only changes that we made through the city planner's office, as Trex has downloadable ICC-ESR reports that were satisfactory to the city engineer.

While we were installing the decking, there were some areas where it had to be scribed to fit snugly against a stone-veneer wall. We always spend enough time on scribes to get as close to perfect a fit as possible—we call these scribed sections of decking the money pieces, because they are often the first thing a client will notice.

To finish up, we installed over $30,000 worth of Trex composite railing with aluminum balusters and integral cap lighting. To get the right color match, I like to source the railing components from the same manufacturer as the decking; to meet California code, all guardrails must be 42 inches high.

Now that we've wrapped up the deck, the client has invited me back to provide an estimate for the pergola. He wants an open-beam gable-end look—we call it a ski lodge design—which is a lot of fun to frame and a much-needed break from deck work. ❖

Michael Walter owns MLW Construction, in Anaheim Hills, Calif.

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PHOTOS BY GERRET WIKOFF

Installing a Steel Pergola

Assembled like a giant erector set, a structural-steel frame provided a glitch-free installation

by Gerret Wikoff

A client I had helped complete a two-story addition and kitchen remodel a few years ago recently contacted me about building a deck and pergola. He sent some rough outdoor-living concepts to me, which I drew in SketchUp. After a few go-arounds, he settled on a design he liked.

The client found and purchased the new pergola system online. The manufacturer was Steel Shade Pergolas (steelshadepergolas.com) located in Tulsa, Okla., a fair distance from sunny Southern California. After the usual delays at the building department, the owner obtained a building permit, which is when I got a look at the pergola manufacturer's plans. The first thing that struck me was the size of the footings: 4 feet square by 2 feet deep. Also, I noticed that the pergola was powder-coated steel—with the largest steel member weighing in at roughly 275 pounds.

I contacted the manufacturer to find out why the footings needed to be so large. Though heavy to install, the finish pergola didn't weigh all that much. I was told that because the company sells pergolas nationwide, it has a universal structural design primarily focused on wind loads. Per the manufacturer's data, these pergolas can withstand a substantial wind load of 110 mph in an Exposure B urban-suburban setting. Where this house was located, in the center of Los Angeles, it would likely not experience wind speeds that great; though in nearby Malibu, the Santa Ana winds can reach 70 mph or higher (in December 2011, the Santa Anas were clocked at a continuous 97 mph with gusts up to 167 mph in Malibu).

Planning for a Steel Pergola

As with the kitchen remodel project, the homeowner wanted to do some of the work. He was a capable, hands-on type of client; he did a nice job building all his kitchen cabinets in his garage on his off time. So, we divvied up some of the tasks. He wanted to dig the footings, and later, install the deck boards with low-voltage LED lighting for the treads; this left installing the footing rebar and concrete, erecting the steel pergola, and framing the deck to me and my crew. He also would select the canvas shading he

wanted to use on top of the pergola and install it himself at a later date.

Footings. The pergola design called for three footings laid out in a L shape. After the homeowner excavated the holes for the footings per the manufacturer's on-center spacing, we began to set the forms and set the rebar. The structural drawings called for two mats of #4 rebar at 10 inches on-center in each direction, top and bottom. For the concrete-pier-to-steel-column connection, one of the approved footing designs had a raised 16-by-20-inch-by-8-inch-high center section. We opted to go with this "columns extension" design so the base of the pergola's steel columns would be a couple of inches above grade to avoid rusting (the local soils are clay and typically hold water in winter).

To reinforce the raised center section, we had 12 "hairpin" U-shaped bars bent for the three pier footings. The manufacturer supplied plywood templates to lay out the four galvanized anchor bolts, which secured with double nuts, one below and one above the plywood.

The hairpins were then tied together to form a box shape around the ¾-inch-by-16-inch-long anchor bolts. We wrapped the #4 hairpins with #3 rings to hold them together (similar to a grade-beam rebar-cage assembly) (**Figure 1**).

Important to the foundation layout was that the columns be spaced accurately and oriented exactly 90 degrees to each other—being off here could be an expensive mistake. Since the nuts could be raised or lowered to fine-tune the level of the column base plates, being perfectly level with each other was also a consideration but not as important. For the column layout, measuring off the building wasn't an option because it was out of square. Instead we used a PLS 5 laser to shoot the templates holding the anchor bolts to make sure they were square and spaced correctly.

To align the footing forms so they were square and parallel to the kitchen

Figure 1. In front of the southwest-facing kitchen, the pergola footings are laid out in a L-shape pattern (A). A raised center section of the footing is formed with 2-by stock nailed to wood supports spanned over the excavated holes. A plywood template precisely holds four anchor bolts in position during the pour (B). Pea-gravel concrete (3,000 psi) is pumped into place (C).

Figure 2. Before the columns are set, concrete is removed from anchor bolt threads and the bottom nuts are screwed on (A). Wiring for lighting is fed through the middle tube-steel post (B). The last of the three factory-welded steel base plates is temporarily set—the upper nuts loosely tightened (C).

Figure 3. The homeowner (at center in photo) helps wrangle the first beam into place with the help of a Genie lift (A). The beam is bolted to the posts (B), then the second, longer beam is hoisted into place and secured (C, D).

Figure 4. The base plates are set in their final position (A). High-strength grout is packed firmly in place about 1 inch thick to fill any voids (B), then tooled at an angle (C).

exterior wall, I pounded rebar pins in the dirt and tied string to them. We then spanned wood supports over the hole and nailed 2-by forms for the raised centers to the supports. We suspended the top rebar mat from the wood supports with wire and supported the bottom mat on blocks placed on the bottom of the hole; the rebar "cages" were tied off to the rebar mats. For the center footing, at the inside corner of the "L," we roughed-in electrical conduit for future lighting and power; the homeowner didn't want to pay an extra $2,000 for the factory lighting.

The inspector had come and approved our work and we were just about to pour the concrete when the rain began. As the holes for the pier footings in the clay soils filled with water, the bottoms softened into sticky brown mud. What was supposed to take a couple of days stretched out into a couple of weeks. Pumping the water out did little, so the owner removed our steel and forms. Sunny skies returned, the pads dried out, the owner dug out the fallen-in mud, and we had to redo the formwork.

To finish up the footings, we pumped 3,000-psi pea-gravel concrete into the holes. I have found over the years that going with a 3,000-psi concrete instead of 2,500 psi helps reduce cracks and gives my finishers more "cream" to work with to achieve a nice finish in addition to the extra strength.

Erecting the steel. The truck with a gooseneck trailer arrived bearing the steel. The three steel posts and two steel beams fabricated from 6-by-6-by-3/16-inch tube stock weighed anywhere from 150 to 275 pounds each (the biggest beam took five men to carry it to the backyard). Also included in the load were nine 2-by-4-by-3/16-inch steel rafters.

Starting out, we chipped away some of the green concrete to create a recess for the dry pack under the base plates. Then we set the height of the bolts with a laser so they were all uniform. The three posts arrived with 10-by-14-by-3/4-inch-thick A36 steel base plates welded to the bottom with web stiffeners. Two posts were 10 feet 6 inches high, while one was 9 feet 9 inches high.

We lugged them in place, stood them on the bolts, and loosely tightened the upper nuts. Steel can move or warp when it's being welded due to the high heat of the MIG or Stick welder, but here we didn't have to reject any warped pieces. Then, we raised and lowered the nuts until the three columns were level and plumb with each other (**Figure 2**).

With the columns in place, we could install the beams. I rented a manual fork lift and we hand-cranked the heavy beams up, then jockeyed them in place for bolting (**Figure 3**). Since the tubes

were raw steel on the inside, we applied black silicone caulking around the nuts and washers to keep water out.

Next, we set the base plates into their final position, tightening down on the top nuts, then began to dry pack the plates. We used Rapid Set Blue high-strength grout for our dry pack (I prefer using the Rapid Set Blue rather than a traditional dry pack of sand and Portland cement). One of the crew members mixed it in a tray while another member and I packed it in firmly in place to fill any voids, to an approximate 1-inch thickness (**Figure 4**).

Over the next few days, we framed the deck out of treated lumber 2-by stock (working around the steel columns), poured concrete pads for the stringers, and loaded the excess soil in a low boy for haul off. My next order of business was to rent scaffolding, erect it, and place the rafters on the horizontal beams (**Figure 5**).

I purposely delayed installing the rafters until after the deck was framed so the man on the receiving end of the rafters would have a flat stable platform to set the ladder on. We laid shipping blankets on the beams and the scaffolding to protect the powder coating from scratches. Despite our efforts, there were a couple, and the manufacturer provided the homeowner with a spray can of powder coat touch-up paint.

The nine 2-by-4-by-3/16-inch steel rafters came in two lengths, 4 feet 7 inches and 6 feet 7 inches, with fairly long cantilever lengths. Two welded brackets on either side of the beam marked rafter locations. We set each rafter on top of the brackets and ran a bolt all the way through it to secure it on both sides of the beam. Steel Shade Pergolas designed the connection to withstand wind loads in our environment. We caulked the bolts to prevent water from entering the tube-steel rafters and getting trapped.

Finishing up. With the precision of a cabinetmaker, the homeowner did a nice job installing the deck boards with low-voltage LED lighting for the treads (**Figure 6**). He planned to install canvas-style shading, rather than the more traditional wood-slat shading, for aesthetic reasons (as of this writing, he has yet to complete this work).

The Steel Shade pergola is, for all intents and purposes, a giant erector set. It had a well-thought-out design and it bolted together glitch-free. All it took on my part was a careful layout and using the right equipment to lift the pieces in place. My part of the project was about $4,400, while the homeowner paid for the steel and decking—he didn't divulge his costs. ❖

Gerret Wikoff is a builder-remodeler based in Los Angeles.

Figure 5. The deck is framed around the steel columns (A, B). The tube-steel rafters are bolted to welded brackets on both sides of the beam (C). Shipping blankets on the beams and the scaffolding protect the steel's powder coating from being scratched during installation.

Figure 6. The finished pergola frame (A, B). The homeowner will install canvas-style shading, which will keep afternoon sun from pouring into his kitchen.

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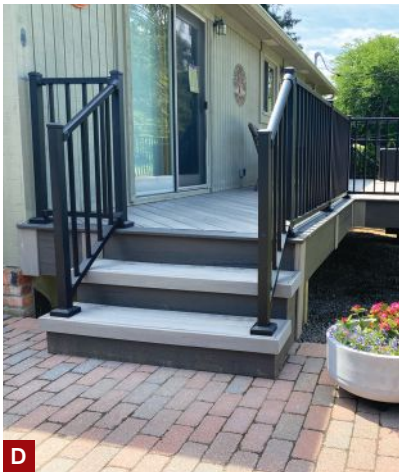
A


B


C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A closed stringer detail looks good but can trap debris (A). On open-stringer stairs, the author cuts nosing returns to mimic the look of interior stairs (B, C). The author's "two-tier" style looks good with contrasting treads and risers (D). The "waterfall" style requires more blocking (E) and can be used with contrasting or single-color tread-and-riser combinations (F).

Deck Stair Upgrades

by Bayn Wood

When we are designing a new or replacement composite deck, we like to offer our clients different stair options to help differentiate ourselves from our competitors. Typically, this includes wrapping the pressure treated stringers with a composite fascia detail that conceals the cut ends of the treads and risers.

In our base stair package, for example, we screw composite fascia boards to the outside face of the stringers. While this closed stringer detail looks good and installs quickly, it tends to collect debris, and we've found that the fascia eventually separates from the framing **(A)**.

That's why I think our open-stringer options are a better upgrade. The first is inspired by interior oak stair treads that have short applied returns to hide the end grain. We cut a short 45-degree return on the tread nosing and a matching 45-degree cut on the return, and fasten the returns to the tread with adhesive—Loctite PL polyurethane construction adhesive for composite treads, and PVC glue with PVC treads—and two pairs of screws—one pair per deck board—that we drive through countersunk holes **(B, C)**.

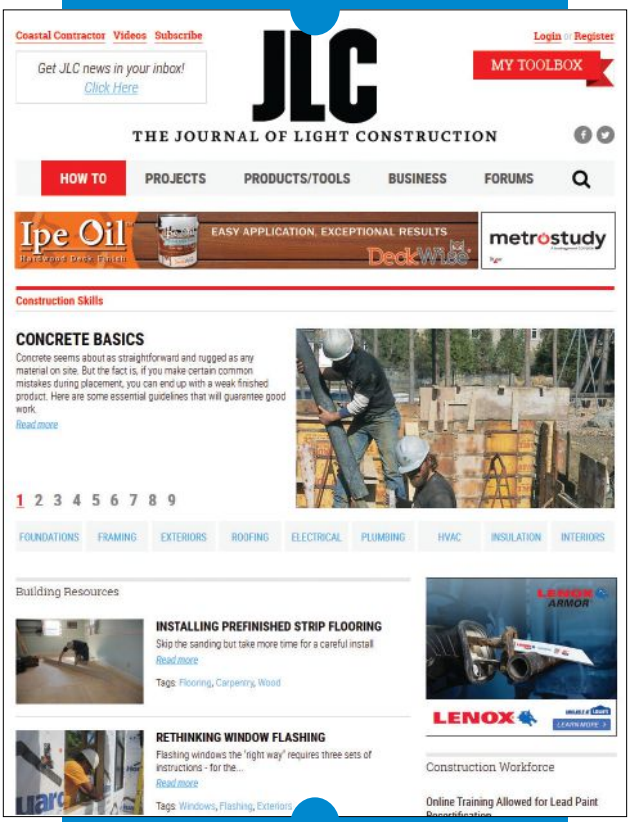
Another option is to wrap the stair risers around the stringers, and then cut the treads flush with the risers. Then we trim the fronts and sides of the treads with solid 5 1/2-inch-wide deck boards ripped down the middle **(D)**.

Our favorite way to finish an open-stringer style of exterior stair is with what I call a waterfall detail. While it requires a fair amount of extra blocking to support the waterfall and the ends of the treads, the detail doesn't require any finicky 45-degree return cuts on the treads. I also like it because the look can be varied by using contrasting or matching colors for the treads and the waterfall **(E, F)**. ❖

Bayn Wood is president of Autumnwood Construction located in Macomb, Mich.

PHOTOS BY BAYN WOOD

JLC



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BY VINCENT SALANDRO

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3

4

1. Hardwood-Mimicking Composite Decking
According to Armadillo, its low-maintenance, high-performance composite deck boards are wrapped on all four sides with polyethylene that emulates a natural wood-grain finish and protects against fading, weathering, stains, mold, and mildew. Available in a range of colors and finishes, a 12-foot board costs approximately $56. armadillodeck.com

2. Multipurpose Plumbing Sealant
Hercules Megaloc Thread Sealant from Oatey is a multipurpose sealant with a nonseparating, nonflammable, and nonhazardous odorless formula. Able to withstand temperatures ranging from -50°F to 400°F without hardening or cracking, the sealant can be used on steel, stainless steel, brass, copper, aluminum, and plastics, and is safe for use on drinking-water lines, according to the manufacturer. A 4-fluid-ounce container costs about $8.50. oatey.com

3. Drywall Corner Beads
Levelline Outside 90 corner beads from CertainTeed have an impact-resistant plastic core, joint tape, and formulated surface paper for improved durability. The manufacturer says compared with paper-faced metal beads, the corners are lighter, easier to handle, flexible, and forgiving, and won't dent, crack, or rust. The joint tape guarantees bonding of the corner to drywall while using less compound and reducing dry time, according to CertainTeed. Corner beads are available in 6-foot-10-inch and 8-, 9-, and 10-foot lengths. certainteed.com

4. Fascia Fastening System
Envision Outdoor Living Products' Deckfast Fascia System, for use with the manufacturer's skirting boards, comprises a Fascia Tool and color-coated Headcote stainless steel or epoxy-coated carbon steel screws. Predrilling with the tool creates oversized holes to help accommodate expansion and contraction of the composite skirting boards. The color-matched screws are then driven into the holes. The manufacturer claims only three fasteners are needed for every 16 inches of fascia. The screws come in 100-count packs to cover 44 linear feet. Contact a dealer for pricing. envisionoutdoorliving.com

5. Stainless Steel Deck Fasteners
National Nail's Camo brand 305 and 316 stainless steel fasteners are suitable for use in coastal and agricultural environments and in applications that face abrasive agents, according to Camo. The line of fasteners includes wood and composite deck and trim screws with 2-inch power bits, as well as edge screws, collated screws, ring-shank deck nails, joist-hanger nails, collated ring-shank framing nails, and collated metal-hanger nails. We found a box of 1,750 3-inch #10 stainless steel bugle-head deck screws for about $400 online. camofasteners.com

6. Exterior Painter's Tape
FrogTape High Bond Exterior Painter's Tape is engineered to adhere to difficult surfaces, like self-cleaning paints, and rough textures, like stucco, brick, and concrete. FrogTape says the tape adheres to uneven substrates and to painted wood, aluminum, steel, and vinyl, while its crepe paper backing allows the tape to conform easily to bends and turns—and then removes cleanly, without shredding. A 1.41-inch-by-60-yard roll is priced at $10.50. frogtape.com

7. High-Tech Lag Screws
The Nova Structural Lag screw features a "Fast Start Tip," which the maker claims provides an immediate grip that reduces splitting and minimizes the torque needed to engage the wood. The manufacturer says the screw's "Twin Blades" help reduce friction and heat on the shank, reduce load on the drill, and remove debris faster than a standard fastener's knurl. Locking wedges help mill and countersink the head into the wood for a clean finish. screw-products.com

8. Lineage Composite Decking
The Trex Transcend Lineage decking line, made from recycled and reclaimed content, features boards with subtle graining. Trex says the boards reflect the sun, staying cooler than other composite decking offerings of similar colors, and are manufactured with Trex's high-traffic formulation and integrated shell that resists stains, scratches, and mold. Lineage boards are available in square and grooved profiles, measuring 1 inch by 6 inches. Square-edged boards come in 16-foot and 20-foot lengths while grooved boards come in 12-, 16-, and 20-foot lengths. lineage.trex.com

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9. Fast-Curing Subfloor Adhesive

LP Legacy Premium Sub-Flooring Adhesive is designed to work in tandem with LP Legacy Premium Sub-Flooring and LP TopNotch 350 Durable Sub-Flooring to create tight seals in small gaps between panels, helping produce a still, squeak-free subfloor system. LP says the gun-applied polyurethane collapsible foam adhesive is fast-curing, 100% solvent-free, and VOC-compliant, and one 29-ounce can provides 12 times the coverage of a typical tube of subflooring adhesive. The adhesive can be applied to wet, dry, or frozen lumber, treated lumber, masonry, decking, concrete, or metal. lpcorp.com

10. Curb Appeal–Enhancing Door Panels

ProVia's 3-inch and 5-inch Simulated Divided Panels (SDPs) for Signet Fiberglass Fir doors provide dimension to entry doors. SDPs can be applied directly to the skin of a solid 001-style door to create horizontal, vertical, or X-shaped panels, or to the surface of a 460-style glass door, incorporating either clear or privacy glass. SDPs are available in a variety of stain, glaze, or paint colors. provia.com

11. Protective Joist Tape

MoistureShield Joist Tape may help to increase the lifespan of both wood- and metal-framed decks by protecting the framing from the elements. The maker claims that the tape's acrylic adhesive and woven cloth substrate form a tight seal over joists and deck screws to prevent moisture infiltration, which can lead to rot and fastener corrosion. The tape can reportedly be applied between -20°F and 200°F and is available in 2-inch-by-65-foot, 4-inch-by-65-foot, and 6-inch-by-65-foot sizes. moistureshield.com

12. All-Electric Cooktop

Thor Kitchen's Professional Electric Cooktops feature touch-screen heat control, nine power levels, and a high-powered 3,600-watt LightningBoil Element. The latter consists of three individually controlled rings and can heat a small pot with one ring or quickly boil a large pot of water with all three turned on. A Sync Burner allows users to evenly heat large cookware by synchronizing both left-side elements for up to 3,800 watts of combined output. Available in 30-inch or 36-inch models, the cooktops are equipped with an automatic shutoff for improved user safety. thorkitchen.com

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Box Truck Makeover

BY EMANUEL SILVA

My first work vehicle was a 1974 GMC Vandura, a no-frills workhorse with no radio, no A/C, and no windows in the back. As my business grew, I switched to a four-wheel-drive GMC pickup truck with a radio and A/C but without the versatility of the van. Looking for a better way to keep my tools dry and organized and transport stock, I purchased my first box truck back in 2002, a Chevy Express 3500 cutaway loaded with options and upfitted with a Supreme cargo box **(1)**. It turned out to be a perfect fit for the way I like to work, with my tools close at hand on the job and a place to put them at the end of the work day. Kept clean and tidy and with my company logo and contact info in big block letters on the sides, the box truck was a rolling advertisement for my business, whether I was driving down the road or parked at a jobsite. I haven't felt the need for a pickup ever since, though I do occasionally miss the four-wheel drive on snowy New England days.

My next box truck was a 2007 Isuzu cab-over with a Utilimaster Trademaster box, a hold-over that I purchased in 2008 **(2)**. With a gross vehicle weight of more than 10,000 pounds, that truck was subject to DOT regulations as a commercial vehicle. But the truck was a beast, lasting well over 133,000 miles on a single set of tires (I drive conservatively and always try to keep weight balanced in the middle of the truck). Made with coated wood-core panels and an aluminum frame, the Utilimaster box was bulletproof.

I replaced my aging Isuzu recently with a 2021 Chevy Express 3500 cutaway fitted with a Reading 10-foot aluminum box **(3)**. As anyone who has recently tried to buy a vehicle can tell you, the process involved long wait times—over six months for the vehicle alone—and limited selection. It also required a bit of a leap of faith, as I had to configure the box online rather than view my options in person at a dealership. The cost for Reading's standard 10-foot aluminum box was about half of what I paid for the vehicle itself. This included remotely controlled locks on all doors as well as a basic LED lighting package, while the roof rack and ladder were options that added about $3,000 to the cost of the box.

Customization. I was very happy with the Utilimaster box, and would have opted for another if it had still been available. The Reading aluminum box is about half the weight, though, and as a result, my new truck is not subject to DOT regulations (though it would be if I pulled a trailer). Another advantage is that the box won't rust. On the other hand, the box is more likely to get dinged and dented from tools and hardware shifting around inside, so while I was waiting for the motor vehicle department to process my registration, I took a few steps to customize the compartments and make the box a little more rugged.

Photos: Manny Silva

The author's first box truck, a 2002 Chevy Express 3500 **(1)**. He bought an Isuzu cab-over box truck in 2008 **(2)**, and used it until he purchased this 2021 Chevy Express 3500 cutaway, which is fitted with a Reading 10-foot aluminum box **(3)**.

The first thing I did was cut face frames and doors out of 3/4-inch MDO plywood to enclose the long shelving units that are built into either side of the aluminum box **(4, 5)**. Aluminum expands and contracts a lot with changes in temperature, so before fastening the frames to the shelving with short stainless steel carriage bolts, I ran beads of OSI Quad sealant over the aluminum where the frames would be attached to keep the assembly from rattling.

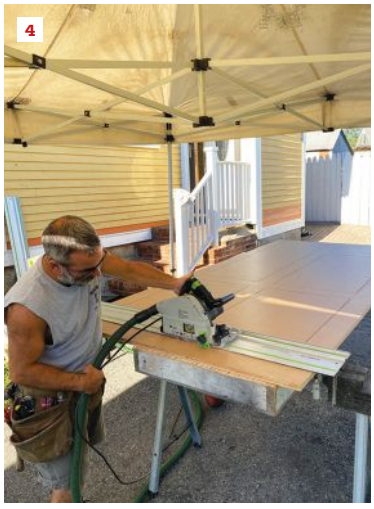
I mounted the doors with stainless steel piano hinges. The doors are hinged at the bottom so that they stay open with the help of gravity, while a pair of thumb latches for each door holds them closed **(6)**.

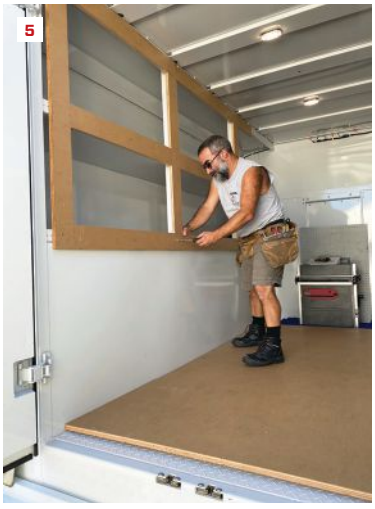
To turn the continuous shelving into individual compartments, I cut dividers out of MDO, which I fastened to the face frames with pocket screws and L-brackets. To prevent tools and equipment inside the cabinets from banging up against the sides of the aluminum box, I cut backers out of leftover cabinet-grade 1/2-inch maple plywood. I fastened the backers to the dividers with micro-pocket screws, spacing them 1/2 inch or so away from the aluminum shell to allow for differential movement of the wood and metal and for ventilation **(7, 8)**.

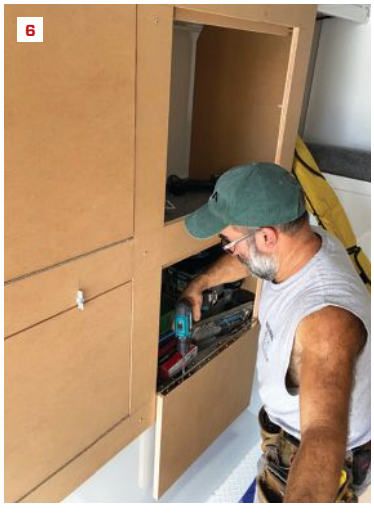
To keep the contents from sliding around, I lined the bottom of each compartment with short-nap carpet, held in place with 3M Super 77 spray adhesive.

Next, I removed the steel pass-through door between the cab and the box **(9)**. Sliding loosely in tracks, the door was unneeded and rattled around. I figured that space would be better used for tool storage, so I permanently filled the opening with a 3/4-inch MDO plywood panel fastened with bolts, first running a thick bead of OSI Quad sealant to keep the panel from rattling **(10)**.

Then I built the raised shelving unit that fits over the space once occupied by the pass-through door. I screwed another, larger MDO panel sized to fit the front wall to the first one, again using plenty of OSI Quad sealant during assembly **(11)**. Next, I fastened MDO cleats to the sides of the







The author bolted simple face frames cut from sheets of MDO plywood **(4)** to divide the interior shelving into compartments **(5)**, then added doors **(6)**, dividers, and backing to prevent damage to the aluminum body **(7, 8)**. To make way for a front shelving unit, he removed the pass-through door **(9)**.

Photos: Corey Silva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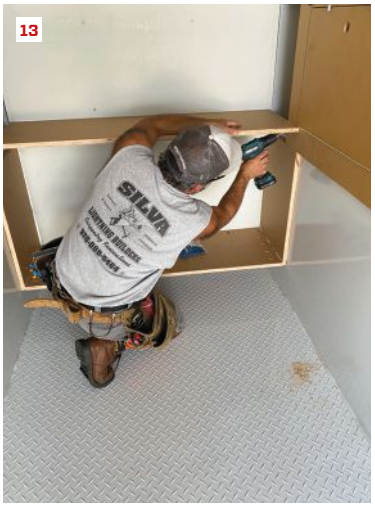
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box, enlisting my son Corey to hold the nuts from the outside while I fastened the stainless steel carriage bolts holding the cleats in place from the inside **(12)**. Finally, I fastened the top and bottom shelves to the cleats and to the back panel with pocket screws and added a few more cleats to keep equipment from sliding off the shelves **(13, 14)**.

Quibbles. As I mentioned, I configured this box online without having the chance to inspect an actual unit, and it turned out that it isn't perfect. For one thing, the ladder has only three rungs, even though the rails extend all the way to the roofline, making the roof rack virtually inaccessible. This is a real head-scratcher.

Another problem is that the back doors swing open only 90 degrees instead of all the way. Because of the thickness of the doors and because the interior walls measure just slightly less than 49 inches apart, I have to tilt 4x8 sheet stock when loading it into the back, instead of just sliding it in. And—again, because of the door thickness—nominal 10-foot framing lumber that measures even a fraction of an inch over 10 feet long won't fit inside.

There is also a bit of leakage when I'm driving around in the rain, both around one of the ladder-rack mounting brackets and inside a couple of the boxes that open to the exterior. The manufacturer apparently anticipated the leakage; the boxes are fitted with removable plugs.

I've finished painting the new cabinetry in the box **(15)** and will soon add the exterior lettering and a set of custom wheels to complete the makeover. I consider the six or seven days that it took me to build out the interior a good investment that will pay me back many times over in increased productivity.

Emanuel Silva, a contributing editor for JLC, *owns Silva Lightning Builders in North Andover, Mass. Contact him at silvalightningbuilders@gmail.com.*

The author replaced the door with a fixed MDO panel **(10)**, then fastened a wider panel with screws and adhesive sealant to act as the back for the front cabinet **(11)**. He completed the cabinet with side cleats **(12)** and top and bottom shelves pocket-screwed to the cleats **(13, 14)**. The front cabinet is raised so that longer stock will fit underneath it **(15)**. The author finished the MDO cabinets with a couple of coats of white paint to brighten the interior.

Flex 6 ½-Inch In-Line Cordless Circular Saw

BY MARK CLEMENT

When I was editor of *Tools of the Trade*, I had a conversation with a tool designer who told me, "We're innovating in a very small space." What he meant, I believe, is that when it comes to circular saws, there's not a lot to add to them that they don't already have. A case in point is the Flex 6 1/2-inch in-line cordless circular saw, which is innovative while at the same time being influenced by other tools, some long and sadly off the market.

The saw is a bit of an oddball. It's a sort of top-handle, sort of in-line, awkward/not awkward belt-drive battery-powered circular saw with a downsized 6 1/2-inch blade. Even so, it has become my everyday carry to the point that I feel awkward using anything else.

My primary focus is as a work-alone carpenter building decks and doing general remodeling activities. I cut enough pressure treated lumber that my blade teeth turn green. I'm primarily making square cuts, so I don't need a tool that will cut deep bevels. But I do need a meat-eater that'll cut my peculiar beam ends and rip soaking-wet 2-by PT stock—and not break my arm off while doing it.

According to the manufacturer's spec sheet, the saw has a cutting capacity of 2 9/16 inches at 90 degrees, and 1 9/16 inches at 45 degrees. It will cut bevels up to 47 degrees.

Blade size and power. Even with a 6 1/2-inch-diameter blade, this saw cuts 99% of everything I need to cut: PT stair stringers, end cuts for joists and deck boards, gang cuts in composite deck boards off the stack (trimmed later with a track saw), long cuts trimming V-joint tongue-and-groove roof deckers or deck boards to length after installation. In fact, it cuts 99% of what I need cut with the base of the saw raised a little off the stock, which makes the blade guard roll easier. The saw is powered by a brushless motor that spins at 5,500 rpm. The included blade is excellent.

In use, the Flex saw reminds me of a couple of saws in the 5-inch range, including Porter-Cable's beloved 314 wormdrive 4 1/2-inch trim saw (no longer in production), and Ridgid's compact Fuego 6 1/2-inch sidewinder. While it is similar in some ways, it is also a lot different. For example, it has a belt drive that offers a plush start and quiet operation with about zero reaction torque.

In-line, blade-left. During my time at JLC Live as a presenter, I discovered that I was cutting like a West Coast wormdrive user but giving myself scoliosis doing it because—as an East Coaster—I was using a sidewinder saw. Learning to cut with one of the wormdrive saws issued by the show staff was a watershed moment for me. With its blade-left design, the Flex saw offers many of the attributes of wormdrive cutting, minus the worm gear, 10 pounds of weight (the saw weighs 7.1 pounds without the battery), the power cord, and wrist twist on every cut.

Lines of sight to the blade are magnificent. The stout aluminum shoe is clearly stamped with the blade kerf and location; so well, in fact, that I actually use the shoe sometimes. Its thickness rides along my square (I use the square as a guide; such a labor saver and the cut is dead-on). Though I'm not gentle with the tool after the cut and let it hit the ground, it comes back square.

The Flex 6 1/2-inch cordless saw has a blade-left design, an adjustable dust port, and a cutting capacity of 2 9/16 inches.

Top-ish handle and dust chute. This confluence of design features is where this saw really starts to overlap—and I don't know if this is intentional by Flex—with tools of yore.

This tool is so top-heavy—tall, really—you can't put it down like a sidewinder or worm drive. You have to lay it down (it takes a hot sec to change the neural pathways, but it works).

This is reminiscent of the old DeWalt worm drive that won many *Tools of the Trade* tool tests back when I was editor. It has a similar angle of attack to the work, and it offers an angular reach that is extremely comfortable in many different scenarios.

The dust chute is a thing of beauty. I believe its intended use is a vac hook-up. Since I'm usually more worried about tornadoes or snow on my sites, my main concern for dust is keeping it off the work. Much like the legendary Porter-Cable "chimney," the Flex ejects dust from an elbow at about 1 o'clock on the blade. It works fabulously well. What's better is that it swivels. Wind in your face? Swivel the chute. Cutting stringers and dust is getting poured on the next cut line? Swivel. Dust covering a chalk line? Again, swivel. It's awesome.

The standard kit costs $250 and comes with a massive 5.0 amp-hour battery, which is both absurdly gigantic and fantastic. It seems to last forever, but even more, it serves as a secondary "handle" to pressure the saw through the cut. The saw has a rafter hook, which is handy for framing or working at sawhorses, and a built-in LED work light. The kit also includes a charger and tote bag. flexpowertools.com

Mark Clement is a small-town carpenter in Ambler, Pa., author of The Carpenter's Notebook A Novel, *and member of JLC Live Demonstration Team. Follow him on Instagram at @myfixituplife.*

Photo by Mark Clement

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BY JLC STAFF

The Cocoanut Grove Fire, Lessons Learned

Eighty years ago, on November 28, 1942, just after 10 p.m., a 16-year-old busboy had been ordered to fix a light bulb located at the top of an artificial palm tree at the Cocoanut Grove "restaurant-supper club" in Boston, Mass. (legend has it the bulb had been unscrewed by a patron desiring more intimacy with his date in the Grove's basement lounge). He lit a match to locate the socket for the light bulb, and moments later, a flicker of a flame in the palm tree quickly spread to the highly flammable cloth-covered ceiling **(1)**.

The official Boston Fire Department report states that "from the first appearance of flame until it had explosively traversed the main dining room and passed, almost 225 feet away, to the entrance of the Broadway Lounge, the commissioner estimated at total time of five minutes at most. At this point in time all exits normally open to the public, of which each had something functionally wrong, were useless for a safe escape." A revolving door at the main Piedmont Street entrance was the worst culprit **(2)**; it became jammed as patrons pushed toward the door to escape.

A combination of corruption, greed, and wanton disregard of local fire regulations led to the deadliest "nightclub" fire in U.S. history (Chicago's Iroquois Theatre fire in 1903 ignominiously holds the title of deadliest fire in an assembly occupancy, with 602 fatalities).

So lethal was this disaster—which occurred somewhat ironically in the National Fire Protection Association's own backyard—that it is still taught to this day in architectural and engineering schools, as well as by the NFPA itself, as a cautionary tale.

Lessons learned. As a result of the fire, building codes were amended in Boston and elsewhere. Revolving doors were outlawed (and later reinstated, provided a revolving door is placed between two outward-opening exit doors). Exit doors were to be clearly marked, unlocked from within, and free from blockage by screens, drapes, and furniture. No combustible materials were to be used for decorations in places of public assembly. The definition of places of "public assembly" was changed (surprisingly, "restaurant-supper clubs" had not been considered as places of public assembly in many jurisdictions).

By the numbers. The estimated occupancy of the club at the time of the fire (more than twice its legal capacity): **1,000**

The total number of egress doors on the ground floor (all deemed "functionally wrong ... useless for a safe escape"): **6**

The number of doors hidden behind drapes or locked to prevent unauthorized entry into the two-story, 10,000-square-foot meandering structure: **4** (estimated)

The official number of victims: **492** dead and **166** injured

The approximate number of bodies found piled up at the Piedmont Street revolving door entry: **200**

The approximate number of bodies found at the in-swinging Broadway entry doors: **100**

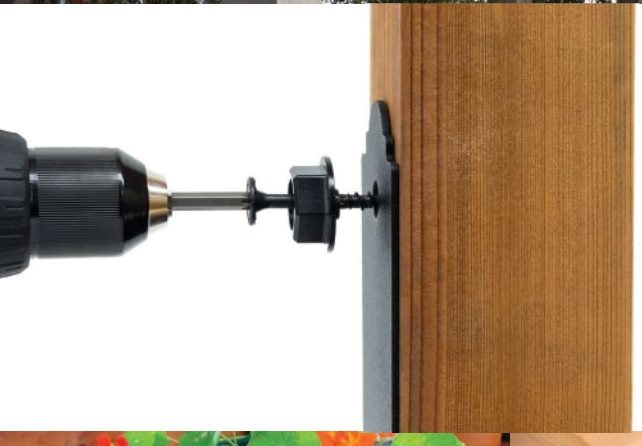
The number of victims received in one hour by Boston City Hospital (a volume that exceeded the treatment rate encountered in London during the Blitz some 18 months earlier): **300**

The years served by Cocoanut Grove owner, Barney Welansky, of a 12-to-15-year sentence for manslaughter before being pardoned for health reasons: **3.5**


1

2

Photos courtesy U.S. Army Signal Corps, Boston Public Library



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